THURSDAY, JANUARY 1, 1920.

BRITISH IRON ORES.

Special Reports on the Mineral Resources of Great Britain. Vol. viii., *Iron Ores: Haematites of West Cumberland, Lancashire, and the Lake District.* By Bernard Smith. Vol. ix., *Iron Ores* (continued): *Sundry Unbedded Ores of Durham, East Cumberland, North Wales, Derbyshire, the Isle of Man, Bristol District and Somerset, Devon and Cornwall.* By T. C. Cantrill, Dr. R. L. Sherlock, and Henry Dewey. Vol. x., *Iron Ores* (continued): *The Haematites of the Forest of Dean and South Wales.* By Prof. T. Franklin Sibly. (Southampton: Ordnance Survey Office, 1919.) Prices: Vol. viii., 9*s.* net; vol. ix., 3*s.* 6*d.* net; vol. x., 4*s.* net.

AS is well known, one of the effects of the recent war has been to direct the attention of the British people to the wealth of the mineral resources of their own country, whereupon it soon became apparent that accurate official information as to the nature and extent of these resources was conspicuous only by its absence. Fortunately, the Director of the Geological Survey, Sir Aubrey Strahan, took immediate steps to rectify this deficiency, and a series of volumes on the mineral resources of Great Britain has been issued under his direction; the last three of these have just been published. These are the opening volumes of a set dealing with British iron ores, and Sir Aubrey Strahan has written a short preface to the first of them, in which he indicates the general scheme which it is proposed to follow. He divides the British ores into "three classes, namely, those products, mostly hæmatites, which occur as replacements, in lodes, etc.; the bedded ores of Mesozoic age; and the bedded ores of Palæozoic age."

This classification is a quite satisfactory one, though the use of the word "lodes" in the above description may well be objected to if it is intended to imply that replacements and lodes are equivalent terms. A typical replacement deposit is certainly not a typical lode; the latter term is identical in meaning with vein, and ought to be restricted definitely to mineral deposits filling fissures, which show for the most part well-defined walls, and have a fairly regular form, so much so that authorities like, *e.g.*, Sir Clement Le Neve Foster, have made them a subdivision of the tabular or sheet-like deposits. It is quite true that the walls of a lode generally show more or less alteration due to the same causes that brought about the filling of the lode itself, and that this alteration may take the form of impregnation or of more or less complete replacement of the country rock, but this fact does not justify calling the lode a replacement deposit. The typical replacement deposit, on the other hand, is, as a rule, quite irregular in outline, and if it does at times assume a tabular form, this is due to accidental conditions, and is certainly not a genetic characteristic.

The three volumes now issued cover the first of Sir Aubrey Strahan's classes, and form geologically the most interesting, but economically the least important, of the three; in fact, it is only the ores described in vol. viii. that possess any economic importance whatever. As regards the economic aspect, it may be considered unfortunate that the authors of the three volumes have put forward statements as to what they consider the probable ore reserves contained in the mineral fields that they have investigated. In the case of irregular deposits, such as are here dealt with, this is a problem of exceptional difficulty, seeing that the data for its solution do not exist, and sound estimates of quantity are impossible; the best that can be done is to make a more or less intelligent guess, and under these conditions the best possible guess is likely to be very wide of the mark. Such speculations are somewhat out of place in an authoritative Government publication, and it is greatly to be feared that heavy money losses may be incurred by adventurers who do not discriminate between the geologist's idea of the quantity of ore that may be supposed to exist and the miner's view of the amount that can be economically extracted.

Apart from his attempt at estimating the probable ore reserves, Mr. Bernard Smith's volume on the West Coast hæmatites is in every respect a very satisfactory one; here the difficulty of forming any opinion as to quantity is peculiarly striking. Owing to the soft nature of the ore and to its highly irregular mode of occurrence, ore reserves cannot be blocked out for any length of time in advance, and there is rarely, if ever, any "ore in sight" in the accepted sense of that phrase, although mines have continued for many years, and will doubtlessly continue in the future, to produce considerable quantities of ore by the hand-to-mouth methods of exploitation which the nature of the deposits renders necessary in the great majority of cases. The volume gives a short but sufficient and very clear description of the geology of the district, and the mode of formation of the ore bodies is described in very convincing terms. It seems impossible to doubt

that the ore was deposited metasomatically, as Mr. Smith asserts; he has, however, avoided the more difficult question, namely, whether the ore was first deposited as a carbonate or as a hydrate, and afterwards metamorphosed to red hæmatite, or whether it was deposited in practically the same form as we now find it. He concurs in the generally received opinion that the iron-bearing solutions were introduced from above, but says nothing as to the theory strongly held by many that these solutions were the result of the leaching out of iron from the New Red Sandstone, which may be presumed at one time to have overlain the whole of the iron-bearing region. The greater part of the book is taken up with a careful, detailed description of the mines, the area being, for the sake of convenience, divided into the Egremont and Whitehaven districts of Cumberland, the Furness district of Lancashire, and the far less important occurrences in the Lake district. Existing mines are fully described under the heads of geological occurrence and mining details, whilst information as to the old and abandoned mines has also been collected. The volume forms a very valuable and welcome addition to our knowledge of this important mineral area.

Vol. x., by Prof. Sibly, is geologically the most important of the three, as it has involved a careful geological study of the Forest of Dean coalfield, with which the iron ores of the Forest are necessarily closely connected. Much new matter has thus been brought to light, and as a result of his work Prof. Sibly has succeeded in proving two important geological facts—one that the Millstone Grit of the Geological Survey is in fact a sandy facies of the dolomitised upper portion of the Carboniferous Limestone, and the other that there is an important unconformity between the Coal Measures and the underlying rocks; it need scarcely be said that there is a close connection between these two facts. This is the first time that a systematic study of the iron ores of the Forest of Dean has been attempted, and Prof. Sibly deserves the highest praise for the manner in which he has unravelled the complex problems that the geology of the district presents. Unfortunately, this field cannot pretend to any economic importance commensurate with its geological interest. The ores, as Prof. Sibly shows, are of relatively shallow occurrence, and have been practically worked out; it is indeed fortunate that the study of this field has not been deferred much longer, for in that case there would probably have been no mines open for the geologist to consider. Prof. Sibly guesses the total amount of ore reserves still existing at about a million tons, but it is very doubtful whether anything approaching this figure will be produced here, and his conclusion "that the Forest of Dean is not far from exhaustion as a source of iron ore" is fully warranted by the facts. The second part of the volume is taken up with a description of a small group of iron-ore mines in the Carboniferous Limestone that forms the south-eastern margin of the South Wales coalfield, extending between Taffs' Well and Llanharry; out of the five mines that have been active in this area, only one, the Llanharry mine, is now at work, producing 50,000 to 60,000 tons yearly; this mineral occurrence is fully described, and particulars are given of the abandoned mines also. In a concluding chapter Prof. Sibly discusses the genesis of all the ores dealt with, and in agreement with most other authorities he looks upon them as undoubtedly of metasomatic origin, due to descending iron-bearing waters; he seems inclined to seek the source of the iron in the Triassic rocks that once probably covered the Forest of Dean area and in the Conglomerates and Red Marls of the Keuper in the South Wales district. The volume contains a mass of interesting information upon the area studied, and as regards the Forest of Dean must rank high as a piece of first-class geological research.

Vol. ix. includes a number of miscellaneous occurrences in different parts of the country, of very various character. It is greatly to be regretted that it falls very far below the high standard to which the other two volumes have attained. It is not improbable that the time allotted to the investigation of each deposit was insufficient, but, whatever be the cause, there are no signs of the painstaking thoroughness which characterises the work already discussed. This volume leaves the impression that the authors merely accepted what they were told in each case, and did little actual field work, or, at the best, only looked at what was shown them. They have thus in many cases arrived at a wholly exaggerated opinion of the importance of the deposits they describe. For instance, in describing the Sharkham iron-ore mine, the authors state that "the amount of ore in sight is considered to be large," whereas as a matter of fact there is very little ore in sight, and they seem never to have heard of the deep adit driven in below the deposits, which runs wholly in barren limestone, and shows that the occurrence is strictly limited in depth. It would serve no useful purpose to multiply examples of such oversights; it is, however, fortunate that none of the occurrences described in vol. ix. have any real economic importance.

The Geologial Survey and the country may both fairly be congratulated on the continuation of Sir

Aubrey Strahan's special reports, and it need scarcely be said that the further volumes dealing with the other two classes of iron-ore occurrences will be eagerly awaited by the large body of workers interested in British iron ores.

H. LOUIS.

ALCOHOL.

Alcohol: Its Production, Properties, Chemistry, and Industrial Applications. With Chapters on Methyl Alcohol, Fusel Oil, and Spirituous Beverages. By Charles Simmonds. Pp. xx + 574. (London: Macmillan and Co., Ltd., 1919.) Price 21*s.* net.

MR. SIMMONDS, one of the senior analysts in the Government Laboratory, is well qualified by his position to undertake the compilation of this book, since his duties have rendered him familiar with his subject in all its aspects—its production and industrial applications, its chemistry, and its special relations to the revenue.

The work treats of the early history of alcohol; its origin and composition; its production by fermentation and by synthetic processes; the nature of the materials employed; the biochemical agents involved; and the general operations of distillation and rectification. The author devotes a chapter to the general chemistry of the homologues with which ordinary or ethyl alcohol is associated, either as a product of fermentation, or in industry as methylated spirit. He is, by virtue of his office, naturally concerned with the analytical chemistry of these alcohols, especially of ethyl and methyl alcohol, and with the subject of alcoholometry, in this country and abroad, and he writes with special knowledge and authority. He gives a sufficiently full account of the fiscal relations of ethyl and methyl alcohol and of the different forms of "denatured" alcohol, as used in industry; treats of various spirituous beverages, their origin, nature, and chemical examination, and concludes with a concise statement of what is definitely known concerning the physiological properties of alcohol. It will be seen from this short summary that the book constitutes a comprehensive treatise in which practically everything relating to alcohol finds a place. It is, of course, essentially a compilation from numerous sources, the range and extent of which may be inferred from the excellent bibliography appended to the work. But the compilation was well worth making, and has resulted in a complete and well-arranged monograph; it is eminently readable, and the information is sound, accurate, and up to date.

Although the practical brewer and distiller will find much in it that will be of use to them at times, the book is not primarily intended for use in the brewery or the distillery. Technical details, such as are to be found in standard treatises on brewing and distilling, and which are the subjects of the trade journals, would be out of place in a work of this kind, where alcohol, as such, is the main consideration.

For the commercial production of alcohol from wood by Classen's process, or some modification of it, there is apparently no future in this country, and it would seem to be doubtful whether any permanent success will be possible even in countries where wood-waste is more plentiful than with us. Alcohol from sulphite-waste liquor in the manufacture of wood-pulp is, however, being produced in considerable quantities in Sweden and elsewhere, and bids fair to become an important industry. Synthetic alcohol from acetylene, derived from calcium carbide, has been made in Germany by methods which were largely developed during the war, mainly in consequence of the shortage of potatoes. It remains to be seen whether the manufacture will become permanently established. The synthetic production of alcohol, if greatly extended, would be certain to produce considerable economic disturbance in Germany, and would also occasion much perturbation in agrarian circles. The danger was foreseen by the late Government, which, by the Spirit Monopoly Act of 1918, placed the manufacture of synthetic alcohol under the control of the State.

In describing the properties of methyl alcohol, the author rightly lays stress on its toxic character. It is far more dangerous than is generally known. It is alleged that the shortage of whisky during the past four years has led to a great increase in the drinking of methylated spirit. Ordinary mineralised methylated spirit, which is the only form to which the public has ready access, contains wood naphtha and a certain amount of mineral naphtha, in addition to ketones and other substances, and is a very noxious beverage; its habitual consumption quickly results in blindness, paralysis, and death. The detection of the presence of methyl alcohol in mixtures containing ethyl alcohol has naturally received much attention in the book. The matter is of fiscal importance, in view of possible illicit attempts to use "denatured" alcohol instead of duty-paid spirit. It has given rise to an abundant literature, a critical synopsis of which is given by the author, to whom the problem has a special professional interest. Many of the methods described are highly sensitive and characteristic, and there is no practical difficulty nowadays in recognising

the presence of methyl alcohol in alcoholic mixtures or in ascertaining its amount.

The author deals with the question of alcohol as a fuel, especially in the internal-combustion engine, and gives details of the results of special investigations which have been made in America and in Australia to elucidate its relative advantages as compared with other forms of motor spirit. Lastly, his chapter on the physiological effects of alcohol gives a careful summary of our present knowledge of its action on the human organism, mainly based upon the report (published in 1918) of the Committee appointed by the Central Board (Liquor Traffic) of the United Kingdom. It is a well-balanced and impartial account of established fact concerning a most important subject, intimately related to the national welfare.

The book is well illustrated; indeed, this, perhaps, constitutes its only demerit; the necessity to use so-called "art" paper throughout in order to reproduce the large number of "process" figures adds greatly to its weight, and thus detracts from its general utility. We would willingly have dispensed with many of the pictures, some of which add little or nothing to the attractiveness or usefulness of the book. Its convenience in handling, and as a work of reference, would thereby have been increased.

A GREAT ARTIST OF NATURE.

A Naturalist's Sketch Book. By Archibald Thorburn. Pp. viii+72+60 plates. (London: Longmans, Green, and Co., 1919.) Price 6 guineas net.

ALL artists are more or less influenced by the work of some previous craftsman whose technique they admire, and it is no detriment to the achievements of so superb an artist as Archibald Thorburn to say that on him has fallen the mantle and style of Joseph Wolf, the greatest artist of bird and mammalian life the world has ever seen. Thorburn himself admits this influence, and renders an adequate tribute to the bygone master. Yet, whilst the care and delicate handling of birds, mammals, landscape, and natural features bear some similarity in their rendition to Wolf in treatment of form and sense of beauty, Thorburn's style is all his own and distinctly original. In one respect, at least, and that a most important one, he excels even Wolf for the beauty, accuracy, and strength of his colour. This has never been surpassed by any artist of ancient or modern times in water colour.

In the work before us we are presented with a series of finished sketches, mostly in colour, and drawn direct from life. Having for his models the most restive and elusive of all sitters, the average artist is content to draw roughly in pencil characteristic poses, and then has to rely for colouring in his details of feather and fur on such skins or stuffed specimens as he is able to procure. Thorburn, it is true, uses only such aids *afterwards* to correct the coloured sketches he makes direct from Nature, and thus he obtains the proper lighting and the real effect of fur and plumage as it is in Nature. Thus he gives us a perfectly satisfactory representation of the creature depicted, and with all the effect of true colour without ultimate studio work, which is always liable to inaccuracy. No one, unless he is an artist himself in this difficult line, has any idea of the rapidity, skill, and accuracy of observation that are required to be *always* successful, and whilst it may be said that even Thorburn occasionally fails slightly in his drawing, 99 per cent. of his work is beyond criticism, and perfectly successful.

In no family of birds is Thorburn more complete in his knowledge than in the case of the game birds and raptorials. His eagles, falcons, grouse, partridges, and black game are drawn from life with a dexterity that is amazing. He puts a wealth of colour and a "bloom" on his plumage that we who know these birds best are left in wonder at his skill. There are just the right softness and rotundity all done with a few unlaboured washes. Details of the plumage in the form of primaries, secondaries, scapulars, and tail are, in the case of each species, rendered with exactly the right number of feathers. No point that is characteristic of any species is lost. A golden eagle in repose shows just the one fluffy feather on the flank, and in flight the striking whites of the under-feathers, which show only when the bird is in movement. We do not need to be told that the series of sketches of game birds, hawks, owls, and smaller perching birds are drawn direct from life, because here, in this beautiful volume, we who are naturalists see them as they really are in all the beauty of life and movement. Perhaps Thorburn is more successful with creatures in repose than in intense action, but this may be due to the fact that the public prefers birds and mammals in their quieter moods, and he likes to render them so.

Probably the artist's work is most successful because he takes such infinite care with all his details before attacking his finished pictures. If he has to do a plate for some work, one or two coloured figures from life are not sufficient. He draws carefully all the "soft" parts, such as feet, bills, and eyes, directly from some dead or living

specimen, and thus gains a first-hand knowledge of the whole creature before commencing his final essay.

The text which the artist supplies of how and when he made his sketches, supplemented with original observations of the habits of birds and mammals, is both adequate and interesting. At the end of the volume are some beautiful studies of landscape and plant life, notably the exquisite sketch of a thistle (plate 60), snow-covered furze and pines (plate 58), the eagle's hunting-ground (plate 57)—a perfect handling of the high tops—and pheasant covert (plate 56).

The volume will do much to enhance the reputation of Archibald Thorburn as an artist, and those possessed of the necessary wealth have the opportunity of purchasing something that will live as long as the taste for Nature, high art, and beauty continues—and that remains for ever.

It is an unfortunate truism that few men, least of all artists, are recognised as supreme craftsmen during their lives. The day is coming shortly—if it has not already arrived—when the public, and even art critics, will awake to the fact that this century has produced two great artists of Nature—namely, Joseph Wolf and Archibald Thorburn—and those who possess a complete set of the work of these two masters will be very fortunate.

In the volume under review we notice only two slight errors. We have never seen a white-tailed eagle (plate 4) so dark as the specimen figured, nor have we observed a green cormorant (plate 36) with a "bushy" crest of the shape depicted.

J. G. M.

SUBMARINES AND SEA POWER.

Submarines and Sea Power. By Charles Domville-Fife. Pp. viii+250. (London: G. Bell and Sons, Ltd., 1919.) Price 10*s.* 6*d.* net.

THE author has already written several books dealing with the development of submarines and also with their exploits on actual service under war conditions. In the present volume an attempt is made to discuss the influence of the submarine, now an important weapon in naval warfare, "on national life in time of war in order to awaken those who administer the empires of to-day and to-morrow to the need of provision against a new and growing menace which has changed the older theories of sea power."

Much of the matter in this book has already been covered in the author's previous publications, particularly that in the chapters on the evolution of the submarine. The difficulties of navigating the submarine, the restrictions imposed by limited depth of water and other hydrographical features, the conditions for favourably attacking an enemy and for escape from one, and other factors dealing with the employment of submarines, are dealt with in some detail, particularly in so far as they affect the use of naval power. The immediate effect of the German submarine menace upon our "sea power" during the Great War is discussed, and the author makes some suggestions based on our recent unpleasant experience for the guidance of future administrators.

So long as details of construction and of working the submarines are under review, the author is on safe ground, but in developing general arguments, in stating his premises, in the marshalling of his facts, and in selecting his language, he is not so happy. A plaintive appeal is made in the preface that the book may be read to the end before any definite opinion is formed. The appeal is necessary.

The author has not considered his subject on broad lines. When one has defined a submarine as a mobile ambush which can be set not only on this side of an enemy, so that he will have to encounter it in his advance, but also well within the enemy lines without incurring any serious risks, and with a considerable degree of protection by reason of its power of submergence, whilst retaining its powers of observation, the serious restrictions it imposes upon the movements of a surface fleet become almost obvious. The submarine affects enormously the tactics of a surface fleet, but the experience of the war has not shown that the submarine has appreciably altered the application of naval strategy. It will alter types of ships.

A picture is drawn or suggested of what might have happened to our sea-borne commerce had Germany possessed at the outbreak of war 1000 high-powered submarines. Such a picture is not instructive in any way in regard to the future aspect of the submarine question. The success of the German submarine—for it was undoubtedly a most successful weapon for harassing our sea power—as a matter of fact lay in its surprise application contrary to the Hague Convention. Had Germany possessed 1000 submarines Britain would have had in all probability 10,000 partial antidotes. Fortunately, such favourable conditions for surprise by submarine cannot occur again. A measure of the success of submarine activities is obtained from the book, in which it is stated that 600 merchant ships and fifty warships were destroyed, and that 1500 patrol ships, with guns and ammunition and depth-charges, and 2000 minesweepers had to be built or used in combating submarines.

The chapters at the end of the book dealing

with sea power and some economic and international problems should be read. Attention is directed to the necessity for the revision of international law and to its enforcement in regard to matters affecting the mercantile marine. International law as developed from previous war experience must of necessity be inapplicable to wars such as that just concluded, in which, instead of small navies and armies, we had nations in arms when every import is almost certain to be contraband.

The title given to the book brings disappointment, for the author does not give a general treatment of the effect of the submarine upon sea power in the future. He pictures many trees, some of the soil, much undergrowth, but one never seems to see the forest. A. B. T.

OUR BOOKSHELF.

Studies in the Construction of Dams: Earthen and Masonry. Arranged on the Principle of Question and Answer for Engineering Students and Others. By Prof. E. R. Matthews. Pp. v+43. (London: Charles Griffin and Co., Ltd., 1919.) Price 4*s.* 6*d.* net.

WE gather from the preface that this little book is intended to be of assistance to students preparing for the examinations of the Institution of Civil Engineers, the B.Sc. (Engineering) of our universities, or other similar examinations. The text is arranged in the form of "question and answer," and includes references to some of the more important dams constructed in different parts of the world. Students who are pursuing systematic courses in the principles of engineering will find a good many statements open to criticism. Thus, at the foot of p. 1, we read: "In a low dam BC may be taken as being equal to AB." ABC is the pressure diagram, and surely this statement regarding BC is not independent of the scale of pressure employed. Again, on p. 1: "The centre of pressure passes through the centre of gravity of this triangle"; and on p. 9: "The centre of pressure acting at a point H/3 above base." On p. 3, r^bH^2 should read rbH^2, and there are several other misprints. On p. 4 the reader is told that the weight of the wall will act through the centre of gravity of the section, but receives no directions as to how to find this point, although space is wasted on p. 25 in answering the questions how to find the centre of gravity of a triangle and parallelogram. We hope that questions such as No. 7, p. 15, do not occur often in professional or university examinations: "What are the suggestions made by Molesworth relative to the thickness of high and low masonry dams?" On p. 16 we read some curious statements, and quote a typical one: "g = specific gravity of the masonry = for light masonry 130 lbs. per square foot = 2·08." It is not possible in the limits of a short notice to deal with every point which might be criticised, but probably enough has been said to justify the conclusion that it would be well to give the book a thorough revision.

Immune Sera: A Concise Exposition of our Present Knowledge of Infection and Immunity. By Dr. C. F. Bolduan and J. Koopman. Fifth edition, thoroughly revised. Pp. viii+206. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1917.) Price 7*s.* net.

THE present edition of this book has been revised throughout, and fresh details have been inserted where necessary. It gives an excellent and, on the whole, a simple account of the salient facts connected with infection and immunity, antitoxins and other sera, cytotoxins, opsonins, vaccines, and other reactions of immunity, and the practitioner will find it a trustworthy guide to modern views on these subjects. We suggest that the details of the partial saturation method and of "toxin spectra" in connection with antitoxins are somewhat beyond the general scope of the work, and that the space devoted to them might be better employed in extending the more directly practical subject of agglutination. The technique of the Wassermann test for syphilis has been included in this edition in response to many requests for information concerning it. Here, again, we think that the description is too technical for the average reader, and might be simplified with advantage. These, however, are minor faults, if faults they be, and do not in any way detract from the general excellence of the book. Several figures serve to visualise the descriptions given in the text, and the book is very readable.

R. T. H.

Handbook of Mineralogy, Blowpipe Analysis, and Geometrical Crystallography. By Prof. G. Montague Butler. Pp. ix+311+v+80+viii+155. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1918.) Price 16*s.* 6*d.* net.

THIS book is in three parts, which are separately paged. They are also on sale separately. The first part consists of concise, clearly printed descriptions of the different mineral species, and should prove useful for their recognition by the student or prospector. This will be facilitated by the use of the folding tables of the physical characters of the different minerals, which are a special feature of the work. The second part deals with the blowpipe analysis of minerals. Here also the results are set out in a convenient tabular form. The third part, which is devoted to crystallography, is not so satisfactory. The author has a system peculiar to himself of describing crystal symmetry which is by no means clear. He is also exceptional at the present time in retaining the Weiss system of notation of crystal faces.

J. W. E.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Atomic Energy.

REFERRING to the notice of my recent Trueman Wood lecture on p. 420 of NATURE of December 25 last, let me explain that I admitted that we could not at present tap or utilise intra-atomic energy except what is given us spontaneously. But we may claim to be utilising intra-atomic properties, since without some kind of disintegration the right kind of projectiles would not be available. I say clearly in the lecture "it is atomic properties rather than atomic energy that are at present being utilised" in wireless telephony.

Furthermore, although the excitation of healthy retinal nerves is primarily dependent on the energy of incident light, yet the action is as if the atoms of a retinal substance acted as accumulators, storing up an æther disturbance of quite unphysiological frequency until a quantum has been collected, when a stimulating projectile is liberated. If anything like this happens, the energy actually utilised is atomic energy; for if that had no existence, the light-waves would be powerless. There may be pathological cases where optic-nerve stimulus is independent of received luminous energy, but that is a highly undesirable state of affairs.

OLIVER J. LODGE.

Metamorphosis of Axolotl caused by Thyroid-feeding.

THE fact that a diet of mammalian thyroid will induce frog-tadpoles to metamorphose precociously into the adult form is now well established. It is of some interest to find that this diet produces a similar effect in a form which usually does not metamorphose—the Axolotl. This is the larva of a salamander known as Amblystoma, but is remarkable in being neotenic, *i.e.* it normally fails to metamorphose, and attains full size and sexual maturity while keeping its larval characters. Chief among these are the external gills and the fin along the back and both borders of the tail, but the adult also differs from the larva in colour, in shape of head, in the development of eyes and eyelids, in the rounded form of the tail, and, of course, in the use of its limbs for progression on land.

Marie von Chauvin in Germany (*Zeitschr. f. Wiss. Zool.*, vol. xxvii., 1877, and vol. xli., 1885) and E. G. Boulenger in this country (Proc. Zool. Soc., 1913 (2)) have succeeded in getting Axolotls to assume the adult form by forcing them to breathe air, either by keeping them in damp moss or in a gradually diminishing quantity of shallow water.

In conjunction with Mr. D. F. Leney, I have been trying the effect of thyroid diet on Axolotls. Two young specimens, 11·5 cm. and 12·7 cm. long, and therefore presumably between six and twelve months old, were kept in a tank at an average temperature of 15°–16° C. in a depth of water (more than 2 in.) considerably greater than that needed to induce air-breathing. They were fed on ox thyroid, at first three times, and later twice, a week.

The thyroid diet began on November 30 last. On December 15 distinct alterations were visible in colour and in resorption of gills and fin, and on December 17 the stage which is critical in metamorphosis induced by air-breathing (see Boulenger's paper) had been passed, the animals being in Boulenger's stage 6, with only vestiges of gills and fin. On December 19 the next or penultimate stage, with scarcely a trace of larval characters, was reached. The larger specimen, the metamorphosis of which was slightly more advanced, had climbed out of the water up a platform provided for the purpose, and its skin was as dry as an ordinary salamander's. When placed on the table they both walked well, thus differing markedly from the larva, which cannot use its legs efficiently if placed on land. Curiously enough, on the succeeding day the larger animal had returned to the water, where it remained until December 23. It then again left the water of its own accord, and up to the time of writing (December 24) has remained in air. Two other specimens of similar size, fed on worms and kept in shallow water, according to Boulenger's method, have so far shown only minimal changes.

Two points are of special interest. First, the time of metamorphosis—just over three weeks—is much shorter than any previously recorded. Boulenger's larvæ took from twelve to sixteen weeks, Marie von Chauvin's from seven to forty weeks. Secondly, the "critical stage" in the metamorphosis was reached apparently without the animals breathing air at all; *i.e.* two entirely different causes, forced air-breathing and a thyroid diet, can produce the same result—metamorphosis. It was not until December 19 that they were observed to come to the surface for air; and even after that, although possessing no functional gills, they spent much time at the bottom of the water, only occasionally rising to float suspended close below the surface with limbs outspread, after the fashion of newts.

Many interesting problems present themselves, which it is hoped to work out as opportunity offers. Meanwhile, this note is published in the hope that others who possess Axolotls will repeat and develop experiments along these lines. I should be glad to enter into correspondence with anyone intending to work on the subject, with the view of preventing useless overlapping in the working out of the problems that arise; and, further, I should be very grateful if anyone possessing Axolotls, whether young or old, would give me the opportunity of purchasing some, as they are at present very difficult to obtain in the market.

JULIAN S. HUXLEY.

New College, Oxford, December 24.

The Hibernation of the House-fly.

M. DE SEGUY's discovery of larvæ of *Musca domestica* in the bodies of snails, Dr. J. C. Gahan's observations thereon in the *Times*, and the note in NATURE of December 18 last are very interesting to biologists, but it is most improbable that a winter crusade against the Helicidæ would have any appreciable effect in diminishing the summer swarms of flies.

I am led to this conclusion by circumstances under my immediate observation. Round my house is a large flower-garden in which I work constantly at all seasons, desperately worried in summer by legions of house-flies. In the course of forty years I have never come across one of the larger Helicidæ in this garden; and my head gardener, a very intelligent man and a good observer, assures me that in thirty years he has never seen one in the kitchen-garden, which is distant half a mile from the flower-garden. Slugs abound in both, but the only one of the Helicidæ that is found is a very small species with a thin, flattened shell (? *Helix cellaria*, Müller) and a body too small to accommodate the larva of a house-fly. It is also the reverse of abundant. There must,

therefore, be other kinds of *nidus* to harbour the larvæ of *Musca domestica* through the winter.

Monreith. HERBERT MAXWELL.

The Magnetic Storm of August 11–12, 1919.

THE Kodaikanal Observatory magnetographs recorded the "sudden commencement" of this storm on August 11 at 6h. 58m. G.M.T., horizontal force showing an instantaneous rise of 149γ and vertical force about 35γ, while the declination magnet was deflected about 1′ towards west. I have measured the three traces, and, after making due allowance for the errors affecting the hour-marks, the following values were obtained:—

	h.	m.
Horizontal force	6	58·0
Vertical force	6	58·7
Declination	6	57·9

Greater weight may be given to the declination result because of the more sharply defined hour-marks in this trace.

It is of interest to compare this result with the times recorded in England in view of the fact that at Kodaikanal the sun at 6h. 58m. G.M.T. was barely three minutes past meridian passage and only 5° north of the zenith. In other words, this observatory was almost at the centre of the earth's disc as seen from the sun, and it might be supposed that the disturbance would have been recorded here earlier than at other places if it is directly due to emanations from the sun.

Apparently the sudden commencement was recorded at Kew "at about 7h. G.M.T.," and at Stonyhurst at 6h. 50m., while at Eskdalemuir the time is given definitely as 6h. 58m., in exact agreement with my result (NATURE, vol. ciii., pp. 483, 505 and 506).

It seems probable that the impulse is simultaneous over the earth to within a fraction of a minute, but it would be interesting to know the limits of error to which the above times are subject, and particularly whether allowance has been made for the rather large error which may be produced by the mechanism for cutting off the light from the sensitive paper at each hour. J. EVERSHED.

Kodaikanal, S. India, November 25.

Deflection of Light during a Solar Eclipse.

DURING a total eclipse of the sun there will be, as I suppose, an increase of density of the air at the central portion of the shadow. If we imagine the normal atmosphere removed, we are left with a residual atmosphere the refraction effects of which will be changes in the normal refraction effects. The whole point is whether, on reasonable suppositions, this residual atmosphere can produce refraction effects of the order of the observed effects that have been attributed to the gravitational field of the sun.

Let us suppose with Prof. Eddington that the portion of this residual atmosphere concerned corresponding to a star near the edge of the sun's disc has a radius of about 150 yards, and let the index of refraction of the residual atmosphere at the central part be μ_2, and that at the circumference μ_1. Then, as I have shown, the displacement will be accounted for if

$$\mu_2=\mu_1\left(1+\frac{7}{10^8}\right).$$

Assuming that the change of density depends only on change of temperature, we have

$$\frac{\rho_2}{\rho_1}=\frac{\theta_2}{\theta_1}=\frac{\mu_2-1}{\mu_1-1},$$

where ρ_2, ρ_1, θ_2, θ_1 are the increases of density and falls of temperature at the centre and circumference.

Thus we have, approximately,

$$\frac{\theta_2-\theta_1}{\theta_2}=\frac{7}{10^8(\mu_2-1)};\quad \frac{\theta_2-\theta_1}{\theta_1}=\frac{7}{10^8(\mu_1-1)}.$$

We must now make some assumption as to the gradient of temperature, and this is a very important point. It would not, I think, be right to make it uniform or approximately uniform throughout a distance of 150 miles. We will assume that in a distance of 150 yards the increase of temperature is 1/100th part of θ_2. This does not seem to be unreasonable.

We then have $\mu_2=1{\cdot}000007$ for the index of refraction of the residual atmosphere at the centre, corresponding to a lowering of temperature of 6·28° C. at the centre and of 6·22° C. at a distance of 150 yards. If we assume that the increase of temperature at a distance of 150 yards is 1/10th of θ_2, we get the fall at the centre 0·63° C. and that at 150 yards' distance 0·57° C. It will be seen that the greater $\frac{\theta_2-\theta_1}{\theta_2}$, the smaller is the necessary fall of temperature at the centre. ALEXR. ANDERSON.

University College, Galway, December 28.

Entente Scientific Literature in Central Europe during the War.

I WAS much interested in reading Prof. Brauner's letter from Prague in NATURE of December 11. Like Prof. Brauner, I was unable to obtain NATURE during the first two years of the war, and I fully appreciate his joy on obtaining your invaluable journal again, after an interval of more than five years.

Prof. Brauner states that from July 30, 1914, "the Austrian Government prohibited for more than four years the circulation of anything printed in England as a punishment for the regard which, especially during the war, we [the Czechs] have always had for your country."

This statement is misleading, for "enemy" periodicals were withheld from the whole of the Austrian Empire, and not from the Bohemians alone. Prof. Brauner is apparently unaware of the fact that, from 1916 onwards, it was possible for institutes of the Austrian universities and technical high schools to obtain scientific periodicals and publications from Entente countries. The enactment which made this possible did not appear to be generally known, but I am aware of two institutions at least, which made application for, and obtained from the Austrian Foreign Office, the necessary permission; and in neither instance was any difficulty experienced.

The Radium Institute of Vienna was one of the institutions concerned, although at that time several Poles (one of them a Russian subject) and the writer of this letter were working there. What is more, the Austrian Foreign Office was not unaware of this "quasi-international" character of the Radium Institute!

Books were also obtainable, and I know of several men of science of Vienna, Budapest, and even of Prague, who were granted permission and obtained books from France and England through neutral countries.

A few months before the armistice I remember sitting in a Viennese restaurant at the same table as a gentleman, who was voraciously devouring the contents of the *Sketch* and the *Illustrated London News*. To judge from his frequent unsuppressed laughter, one would have thought he was scanning the pages of *Punch*. Not having seen these periodicals for nearly five years, my interest and curiosity were aroused, and I asked this gentleman's permission to

see them. His reply was very emphatic: "Das ist ja ganz unmöglich!" I gathered from his further conversation that he belonged to the Intelligence Bureau of the Austrian Foreign Office, and that his work consisted in reading such journals. I envied him, but could not suppress my feelings of astonishment at his reading such "ganz geheimen Dokumente" in a public restaurant.

It may be mentioned in conclusion that Germany was much more liberal than Austria about the circulation of Entente publications. At least until the later months of the war, it was possible to go into any of the larger *cafés* of the German cities and enjoy a cup of coffee-substitute over a copy of the *Times*, *Le Temps*, *Secolo*, and various other newspapers of the Allied countries.

ROBERT W. LAWSON.

The University, Sheffield, December 17.

Royal Meteorological Society's Phenological Returns.

WITH 1920 the phenological returns complete the thirty years, which period is a recognised critical epoch in meteorological records.

In consequence of the war, our observing stations fell to 110 in 1918, against the high-water mark of 132 in 1914. We are most anxious now to recover lost ground, and would in this respect like to make 1920 preparatory to the years to follow.

A reasonable total would include at least 220 stations, an average of twenty only for the eleven Meteorological Office districts. At present we are short of this in all but South-east England and the Midlands. The six districts forming Scotland, Ireland, and North-east England average only 3½ each. Wales has two stations only, both in the south-west.

The observations asked for refer to the blooming of thirteen common flowers and the appearances of six birds and six insects. Other migrant records and notes are also invited, but these are of secondary importance.

A copy of the observing form and of a recent report will be sent with pleasure (the reports so far as they are available) to any readers of NATURE who would be interested to help.

We especially suggest the value for all interested in Nature-study and regional survey classes.

Inquiries should be addressed to one of us, or to the Assistant Secretary, Royal Meteorological Society, 70 Victoria Street, S.W.1.

H. B. ADAMES,
33 Holcombe Road,
Ilford, Essex.

J. EDMUND CLARK,
"Asgarth," Purley,
Surrey.

Einstein's Theory and a Map Analogue.

I AM grateful to the Director-General of the Ordnance Survey for directing my attention to an inaccuracy in my article in NATURE of December 11, p. 375. It was there stated that it is not possible to strain a map of the earth's surface so that all great circles become straight lines.

This is clearly contrary to the known fact of the central projection. As a matter of fact, the sphere is one of the limited class of surfaces for which it is possible to strain all geodesics into straight lines. For an arbitrary surface this is not true. The difference between the properties of the sphere and of the general surface gives a fair indication of the geometrical notions at the back of Einstein's theory.

E. CUNNINGHAM.

THE SUN DANCE OF THE TETON SIOUX.

AS man advances in the scale of culture he loses his dependence on Nature. The dweller in a modern city relies chiefly on artificial means for his pleasure and comfort, but the American Indian realised that his whole success depended on his co-operation with natural forces. He studied his surroundings and evolved a system of reasoning by which he attempted to explain them. A thoughtful Sioux Indian said to the writer: "When we see the changes of day and night, the sun, moon, and stars in the sky, and the changing seasons upon the earth, with their ripening fruits, anyone must realise that it is the work of someone more powerful than man. Greatest of all is the sun, without which we could not live. The birds and the beasts, the trees and the rocks, are the work of some great power."[1] Having recognised a creative power with the sun as its most important manifestation, it was a natural step in native logic to regard the sun with a reverence that is best expressed by the word "worship."

While the worship of the sun, in various forms, was widespread among the Indians of North America, the sun dance was a ceremony the observance of which was limited to certain plains tribes. The sun dance among the Santee Sioux differed in some respects from that of the Teton Sioux, which is herewith presented, but the underlying idea is the same. The sun dance was "the first and only religion of the Sioux," and even at the present time it is considered too sacred a subject for ordinary conversation. At the opening of the writer's study a member of the tribe said: "If we were to talk of the sun dance there should be at least twelve persons present, so that no disrespect would be shown, and no young people should be allowed to come from curiosity."

The purpose of the sun dance was the public offering to Wakaŋ'taŋka (Great Mystery) of what was strongest in the nature and training of the Indian—namely, his ability to endure physical pain. He did this in fulfilment of a vow made in time of great anxiety or danger, usually when on the warpath. The time of the sun dance was the full moon of midsummer, "when all Nature and even man is rejoicing." Into this joy and beauty, as though to give a greater contrast, the Indian projected his personal suffering. For a month before the sun dance it was customary for the medicine men to "pray for fair weather," singing their songs of magic power, burning sweet grass, and offering their pipes to the sky, the earth, and the cardinal points as they made their petitions. It is said that the oldest men cannot remember the falling of rain during a sun dance.

From long distances the people came and made their camp in a great circle. The dance enclosure was in the centre of this circle, and was about 50 ft. in diameter. Around it was erected a shelter

[1] "Teton Sioux Music." By Frances Densmore. Bulletin 61, Bureau of American Ethnology, Smithsonian Institution, Washington, D.C., p. 96. Other direct quotations, as well as the facts herein presented, are from the same work. The Bureau of American Ethnology has kindly given permission to reproduce the illustrations used in this article.

for those who witnessed the ceremony. The sun-dance pole was placed in the centre of the dance enclosure, and near its entrance, which was toward the east, a large drum was placed, the singers being seated around this drum. About 15 ft. west of the pole a square of exposed and finely pulverised earth was located. This was called the "sacred place," and its preparation, as well as the securing and erection of the sun-dance pole, were accompanied by ceremonial songs and action.

The tree for the sun-dance pole was sought as men seek an enemy. It could be cut only by a virgin selected carefully from the tribe, and the song while it was being felled was a song of war. The branches were cut off, and in a triumphal manner the pole was carried to the camp, where it was painted in vertical red stripes by the leader of the ceremony. The people watched the painting and erection of the pole with deep reverence, and listened while the leader sang the sacred songs that had come down to him through many generations —the songs of Dreamer-of-the-Sun. In one of these songs the pole speaks, saying: "Sacred (made holy) I stand"; and after the pole was in position the words of the song were: "Grandfather, at the places of the four winds may you be reverenced. You made me wear something sacred. The tribe sitting in reverence, they wish to live." The "sacred place" was then prepared, the earth being finely pulverised and two intersecting lines drawn in it, forming a cross. In these lines tobacco was placed, then covered with vermilion paint-powder, and over this was spread powdered gypsum, shining white in colour. At the intersection and ends of the lines were placed bunches of downy white eagle feathers. West of this was spread a bed of fresh sage, on which a buffalo skull would be laid during the ceremony, and between the two was a "pipe-rack" to support the stem of the ceremonial pipe. The people watched this also in silence, and the leader sang the following song: "Four times to the earth I prayed. A place I will prepare, O tribe, behold."

The sun-dance pipe (Fig. 1) was decorated in a prescribed manner by one of the most skilful women of the tribe. This pipe was carried by the leader of the dancers. Those who took part in the dance wore their hair loose after the custom of men who had recently killed an enemy. Each man wore a deer-skin apron that extended to his knees back and front. An eagle-bone whistle was hung around his neck, and on this whistle he blew as he danced.

FIG. 1.—Sun-dance pipe.

FIG. 2.—Knife used in inflicting sun-dance torture.

The torture of the sun dance was inflicted by the insertion of a short stick or skewer through the flesh of the chest or back, and placing a strain upon this until the flesh tore, releasing the man. While the word "flesh" is commonly used as suggesting the severity of the ordeal, the Indians said that "the stick was put through the skin." It probably penetrated also the subcutaneous fascia. A knife used in making the incisions is shown in Fig. 2, together with the shield covering the point of the knife when not in use. A man accustomed to the work lifted a small portion of the man's flesh (or "skin") between his thumb and finger, thrust the knife through it, following this with the pointed stick. The strain on the stick was secured by tying to it the ends of thongs that hung from the cross-bar of the sun-dance pole, the length of these being such that the man

was only relieved from the strain by rising on his toes. He was, however, expected to dance until the flesh gave way. Others dragged buffalo skulls attached to their backs, and a man might request that the stick be tied to his horse. Another form of torture consisted in the cutting of gashes in arms and body. A man when making his vow designated the manner of its fulfilment, and those who witnessed the vow were expected to see that it was carried out.

After a man released himself it was customary to apply a powdered herb to the wound, which healed in a short time; it is said that even a swelling of the wound was unknown among the Sioux. The man then resumed dancing with eyes steadily fixed upon the sun, and continued dancing without food or water during that day and the following night. As the sun rose on the second day it was greeted by the leader with this song: "Here am I, behold me. I am the sun, behold me."

The scene of a sun dance, while the men are still dancing, is shown in Fig. 3, a drawing by a man who had taken part in the dance. The suspension from the pole and the carrying of buffalo skulls are seen, though the buffalo skulls were usually allowed to drag on the ground. The pole is decorated with streamers, and from the cross-bar are hung two effigies cut from raw hide, one representing a man (an enemy), and the other a buffalo. The drum is seen at the right with two singers beside it, and in the upper left-hand corner two women are carrying kettles of food. Feasts were often given in honour of young men taking part in the sun dance for the first time, and in the camp there were various events taking place during the dances.

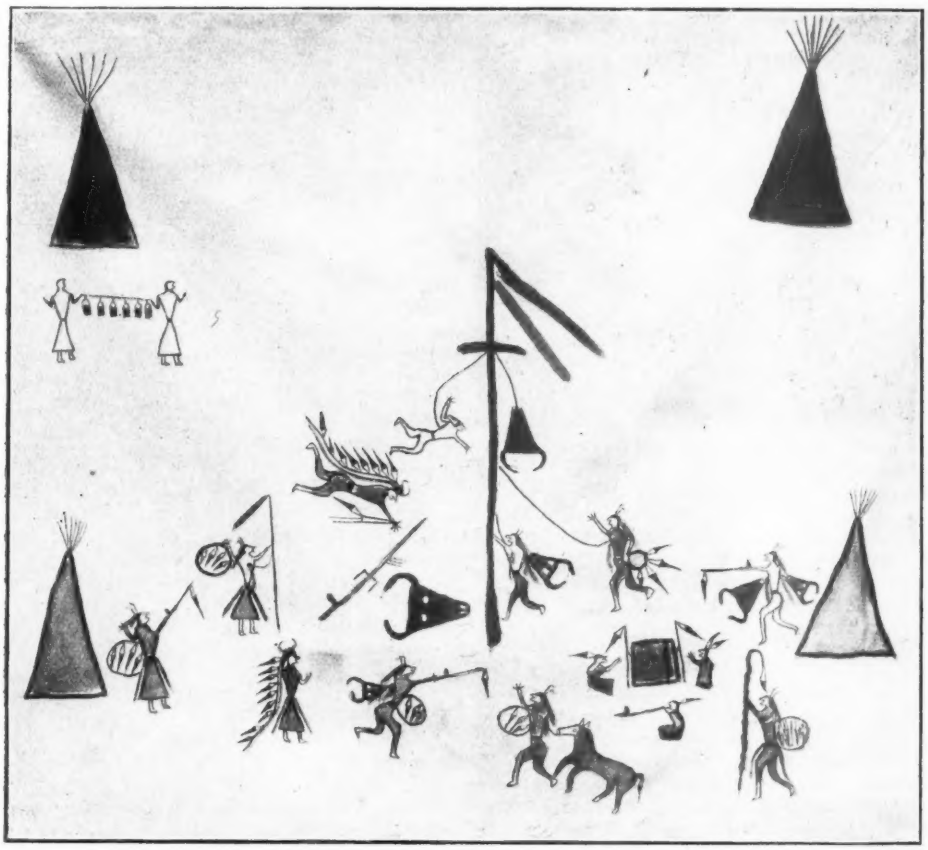

FIG. 3.—Native drawing of sun-dance.

During the second day the men fell from exhaustion, and after being carried into the shade they gradually regained consciousness. The evening of that day saw the sun-dance ground deserted, as it was the custom that all the people take their departure before sunset of that day.

While the element of pain forces itself on our thought, it is interesting to note the unselfishness underlying it. As the men were dancing they "prayed for all in the tribe, especially the sick and

the old," believing that "an act performed publicly is more effective than the same thing done in private." The men who had taken part in the sun dance were men of fine character. White-

FIG. 4.—White-buffalo-walking, who took part in a sun-dance.

buffalo-walking (Fig. 4) was one of those who fulfilled a vow in the last sun dance ever held by the Teton Sioux, that splendid tribe of the rapidly vanishing race.

FRANCES DENSMORE.

THE INTERNATIONAL HYDROGRAPHIC CONFERENCE.

THE International Hydrographic Conference, which was held in London between June 24 and July 16, will, it is believed, mark a new era in hydrography. The revival of trade, with the consequent increased traffic on the high seas which will accompany it, makes the present time most opportune for the discussion of the methods of charting the seas and the publication of information to ensure safe navigation. Thanks to the initiative of the Admiralty, it was found possible to bring together most of the chief hydrographic experts of the world, and the decisions they have arrived at in the conference, and the general interchange of ideas which took place, will be fraught with good to the seamen of the world. Twenty-three countries were represented at the conference, amongst the representatives of which were the Hydrographers of Denmark, France, Great Britain, Greece, Holland, Norway, Sweden, and the United States of America.

The subjects to which the conference devoted its attention were "Charts," "Sailing Directions," "Light Lists," "Notices to Mariners," "Time Signals, Distance Tables, and Other Miscellaneous Hydrographic Publications," "Tide Tables," "Instruments Used for Surveying on Shore and at Sea," "Time-measuring Instruments," "The Interchange of Publications," and "The Establishment of an International Hydrographic Bureau."

The subjects, it will be seen, practically covered the whole field of hydrography, and the main object of the conference was to compare the practices of all countries, with a view to the adoption by all of the best methods, and so more or less to standardise the hydrographic publications of the world. All seamen will appreciate the benefit which must accrue from the adoption of common methods of producing all information required for their use to ensure safe navigation. The conference therefore divided itself into committees on the various subjects, and from day to day these committees pursued their investigations, finally reporting to the conference the agreements at which they had arrived. The conference, after discussing the committees' reports, recorded its decisions in a series of resolutions, to which the hydrographic authorities of each country will, it is hoped, give effect without delay. The result will be practically to standardise all published hydrographic works, and will amply justify the holding of the conference.

It is not possible in this brief account to enumerate all the decisions of the conference, and only a few of the most important can be noted.

Under the head of "Charts," agreement as to the use of a common set of signs and abbreviations which denote the various features on a chart was arrived at. The adoption of the metric system of measurement for depths and heights was discussed at length, but whilst the conference unanimously expressed the opinion that all nations should, as soon as convenient, adopt it in their charts and publications, it was recognised that it was not possible for the countries not using it in their charts to do so until the metre had been adopted as the general standard of measurement in their respective countries, and it was therefore agreed that those countries not using the metre should insert on their charts tables for the conversion of the measurements used to the equivalent measurements of the metric system, and that in their sailing directions, light lists, etc., the metric measurements should follow the national measurements. The transcription of names received attention, and it was agreed that generally the literal, and not the phonetic, transcription was desirable.

Under the head of "Sailing Directions," the general arrangement of these important addenda to the charts was discussed, and the necessity for the publication of an annual supplement to each volume to bring it up to date was recognised. An improved method of describing tidal streams and currents was adopted. Bearings, it

was agreed, should be given as "true" only, and from 0° to 360° measured clockwise.

The arrangement of the British "Notice to Mariners" met with universal approval, and its form was adopted as the standard for all countries.

With regard to the "Light Lists," the principal alterations and additions agreed to were the inclusion in the lists of "light buoys," "wireless direction-finding stations," and "sound-ranging signal stations." The desirability of finding a satisfactory formula for describing visibility as limited by the intensity of light was recognised, and it was agreed that each nation should make observations and collect data in order that the matter might be dealt with by the International Hydrographic Bureau if ultimately established.

The subject of "Tides" was carefully considered, and the necessity recognised for the adoption of a uniform zero from which heights should be measured, which should also be the datum for soundings on the charts, and of uniform methods of publishing tidal information. A rule for determining a "universal datum plane," to be called "international low water," was suggested for the further consideration of hydrographers, and decisions were reached regarding information to be published in tide tables, and on charts at places where the semi-diurnal tide predominates, but it was unfortunately found that modern tidal knowledge was insufficient for any recommendation to be made as to information which should be given on charts at places where the semi-diurnal is not the predominating tide-wave; this question was therefore left for further investigation.

Interchange of publications, a most important matter to all countries, as each country freely copies the publications of the others, received consideration, and steps were taken to put the matter on a more satisfactory footing.

A number of instruments used by various countries in hydrographic surveying were exhibited, and useful comparisons made and information exchanged.

The adoption by all countries of a system of "time zones" to regulate the time kept at sea, such as have already been adopted by France, Great Britain, and Italy, was recommended.

The last item on the programme of the conference was the establishment of an "International Hydrographic Bureau," and as the work of the conference progressed, the necessity for such an institution became more and more evident. Questions arose upon which an agreement in principle was arrived at, but time would not permit of the necessary details to give effect to the decisions being worked out by the conference, nor was such a large body as the latter found to be a suitable medium for doing so. On the necessity for the establishment of a bureau, which should be a purely advisory body with no executive powers, and of the existence of sufficient work to employ it, there was unanimous agreement. Such a body, it was felt, was urgently required to consider and make proposals for the co-ordination of the work of the whole of the Hydrographic Offices, to study the numerous questions not fully solved by the conference, to act as an authority to which questions could be submitted for advice, to take steps as required to obtain the assistance and co-operation of Governments and Hydrographic Offices when required for the execution of any particular work or research desirable in the common interests of all countries, and generally to watch over and advance the science of hydrography. As a result of its deliberations the conference decided to appoint a committee consisting of Rear-Admiral Sir J. F. Parry, K.C.B. (then Hydrographer of the British Navy), Monsieur J. Renaud, the French Hydrographer, and Rear-Admiral E. Simpson, the Hydrographer of the United States Navy, to prepare for presentation to the various Governments the case for the establishment of a bureau, and to take the necessary steps for its formation when the various countries should have signified their approval of its institution.

With this final act the conference concluded its labours, which, from a hydrographical point of view, cannot be over-estimated, and the results of which will, it is hoped, speedily be apparent in the publications of the various Hydrographic Offices.

A SHAKESPEAREAN GARDEN.

WE learn with interest that the trustees and guardians of Shakespeare's birthplace are laying out the "Great Garden" attached to his house, "New Place," as an Elizabethan garden. The trustees are naturally anxious to plant the garden with those old-fashioned flowers which were grown in English gardens in Shakespeare's day, and they appeal to lovers of Shakespeare and of gardens to help them by contributing the flowers needed to restore the garden, so far as possible, to its original aspect.

Such a garden of old-fashioned flowers is much to be desired in these days, when so many of the old-fashioned, beautiful, sweet-scented flowers are almost lost to cultivation in gardens, owing to their being ousted by the modern creations of florists. No doubt present-day flowers are larger and more brilliant, but we have to a great extent lost the charm, scent, and elegance of the old garden flowers as a result of what may be termed the vulgarity of present-day tastes.

The desire for masses of colour and for magnificence of form no doubt accounts for the lack of interest in the old-fashioned plants, many of which are now scarcely known. Among the plants which the trustees desire to obtain are "sweet musk roses," "roses damask'd red and white," the "crimson rose" and "milk-white rose," all alluded to by Shakespeare. Crown imperials, "lilies of all kinds"—but those known in Shakespeare's time were only a tithe of what are now found in gardens; daffodils—again only a few—and "fleur-de-luce" are all referred to by Shake-

speare, and may be sent. Of shrubs, rosemary, lavender, lavender cotton, box, woodbine, and many others should be planted.

The trustees, in their circular, refer to several early gardening books which give accounts of the plants in cultivation in the latter part of the sixteenth century, but they omit to mention the excellent book by the late Canon Ellacombe, a keen student of Shakespeare, whose "Plant-lore and Garden Graft of Shakespeare" is a mine of useful information on the plants in cultivation in Shakespeare's day. The list of plants grown in the garden at Bitton vicarage in 1831, reprinted in the recently published memoir of Canon Ellacombe, might also well represent what would have been found in a garden three hundred years ago, and should be referred to by those anxious to assist in the good work.

Fortunately, there are still collections of the old roses from which it may be possible to supply plants for the "Great Garden." Anyone having any of the old-fashioned plants suitable for the garden should send them to Mr. Frederick C. Wellstood, secretary to the trust, Shakespeare's Great Garden, New Place, Stratford-on-Avon, by whom they will be gratefully acknowledged. The names of the donors will be preserved at Nash's House, adjoining New Place, which was once the property of Thomas Nash, the husband of Shakespeare's granddaughter Elizabeth.

There are probably many people who would wish to take part in this interesting tribute to Shakespeare's memory, but have no flowers to send; contributions in money from such will be equally acceptable, and should be sent to the secretary to the trust.

A RESEARCH INSTITUTE FOR NEW ZEALAND.

UNDER the will of the late Thomas Cawthorn, of Nelson, New Zealand, the sum of 240,000*l.* was left for the founding of a technical institute. The trustees were unanimous in desiring that the Cawthorn Institute should be a research institution, and appointed a private commission of scientific men to advise as to the best method of procedure. The commission consisted of Sir J. C. Wilson, President of the N.Z. Board of Agriculture, Profs. Benham, Easterfield, Marshall, and Worley, and Dr. Leonard Cockayne. At the request of the trustees, the commissioners have consented to become an honorary advisory board. The main recommendations of the commission have been adopted by the trustees. The chief work of the institute is to be "instruction in and performance of scientific research; such research to be definitely related to the industries of Nelson and of the Dominion."

A beautiful, well-wooded site overlooking Tasman Bay has been secured, the area being approximately 20 acres and the distance from Nelson about three miles. It is expected that the buildings will be commenced at an early date. At the last meeting of the trustees it was decided, with the approval of the advisory board, to offer the position of director to Prof. T. H. Easterfield, professor of chemistry at Victoria College (University of New Zealand), Wellington, who has accepted the position. Mr. T. Rigg, of the Cambridge School of Agriculture, a New Zealand 1851 Exhibitioner, has been appointed agricultural chemist; other staff appointments will be made shortly.

A liberal scheme of scholarships and fellowships is arranged, so that university graduates may be attracted to carry out investigations under the guidance of members of the staff.

An annual "Cawthorn Lecture" has been established. The 1917 lecture was delivered by Prof. Easterfield on "The Aims and Ideals of the Cawthorn Institute"; the next lecturer was Prof. Benham, and the lecturer in 1919 was Dr. L. Cockayne.

Questions having been raised as to the legal right of the trustees to establish a research institute, an originating summons was taken out under the Declaratory Judgments Act. The decision of Mr. Justice Chapman was to the effect that the scheme set out in the report of the commissioners falls, in its main features, within the terms of the testator's intentions. It is proposed to introduce a Bill embodying the chief points of the judgment in the New Zealand Parliament next session.

Though it is intended that the work of the institute is to have a distinct economic bearing, it has been made clear that the trustees recognise that no sharp line can be drawn between technical and scientific research, and that the term "technical" will be understood in a broad and liberal sense.

DR. CYRIL G. HOPKINS.

STUDENTS of agricultural science in all countries will learn with regret of the death on October 6 of Dr. Cyril G. Hopkins, the distinguished head of the department of agronomy in the University of Illinois. Dr. Hopkins had for the past twelve months been studying the exhausted soils of Greece under the auspices of the American Red Cross. He had written his report, seen it translated into Greek, and received a decoration from the King of the Hellenes. He was on his way home, but when three days out from Gibraltar was suddenly struck down with congestion of the brain, with malarial complications.

Dr. Hopkins's chief service to agriculture was his urgent and persistent advocacy of the need for the honest and adequate use of fertilisers. His region of operations was the State of Illinois, of which he had a very extensive knowledge. It was the present writer's privilege to accompany him on an agricultural tour through this State in 1912, and to learn at first hand some of his interesting agricultural deductions and conclusions. Dr. Hopkins's critical scientific outlook was manifested in his lectures and writings. Besides being popular with his students, he had a great faculty for getting on well with farmers, and was obviously a welcome guest in their homes. English agri-

cultural students will remember with pride his high opinion of the work of the Rothamsted Experimental Station, with which he was unusually well acquainted. The Rothamsted data were constantly used by him in lectures and writings, and he maintained his personal interest in the work right up to the time of starting for Greece.

Two of Dr. Hopkins's books are well known in this country. One—"The Story of the Soil"—was written in the main during his long railway journeys in the States; it is an attempt to introduce scientific facts about the soil into the dialogue of a novel. It is not less attractive than other novels written with a purpose, and it is light reading. His more serious book is entitled "Soil Fertility and Permanent Agriculture"; it contains valuable summaries of the results of the more important field experiments, and an interesting and illuminating discussion. His own view was narrower than would be usually accepted by the younger generation of workers in America or in this country; he considered soil fertility to be essentially a matter of nitrogen, phosphate, and potash, and to be expressible in the terms of the actual weights of these substances in the soil. There are cases where this view would suffice, and many appear to have come within Dr. Hopkins's experience. These, however, would now be regarded as limiting rather than as normal cases, and more generally fertility would be considered to be the outcome of many factors, some chemical, some physical, others, again, biological. But Dr. Hopkins did much good work, training a splendid body of students, and developing a department which has added lustre to the great University of Illinois.

E. J. RUSSELL.

NOTES.

WE announce with deepest regret the death on Monday, December 29, at seventy years of age, of Sir William Osler, Bart., F.R.S., Regius professor of medicine in the University of Oxford.

MR. R. NATHAN, late Indian Civil Service and author of works on the history of plague in India and the progress of education in India, has been promoted by the King to the rank of K.C.S.I.; and Mr. G. S. Sankey, Inspector-General of Forests to the Government of India, has been given the honour of K.B.E.

DR. F. BROILI has been appointed professor of geology and palæontology in the University of Munich in succession to the late Prof. A. Rothpletz. Dr. Broili was a pupil of the late Prof. K. A. von Zittel, and is well known for his numerous contributions to vertebrate palæontology.

WE learn from Dr. Tolmatcheff, a Custos of the Russian Academy of Sciences, who is now in London, that when he left Petrograd early last summer the collections and libraries of the Academy, the School of Mines, and the Geological Survey were intact, and scientific men were being sympathetically treated by the Bolshevik Government. The most important specimens of the Permian reptiles collected by the late Prof. Amalitsky in northern Russia had been removed from Warsaw to the museum of the Academy of Sciences at Petrograd.

THE death is announced, in his sixtieth year, of Dr. Louis Valentine Pirsson, who had been professor of physical geology since 1897 at the Sheffield Scientific School at Yale, where for several years previously he had held various minor posts. Prof. Pirsson was a geologist on the staff of the U.S. Geological Survey and an associate editor of the *American Journal of Science*. He was the author of numerous scientific memoirs, text-books, and papers on geological and mineralogical subjects.

THE Photographic Arts and Crafts Exhibition, which was held annually until the war intervened, is to be resumed in the coming spring. It is renamed the Photographic Fair, and will be held at the Horticultural Hall, Westminster, on April 16 to 24. As usual, the Professional Photographers' Association will hold a congress at the same time in connection with the exhibition, while the Photographic Dealers' Association will, for the first time, organise a congress of photographic dealers. It is intended to afford dealers special facilities for examining the exhibits. The organising secretary of the fair is Mr. Arthur C. Brookes, Sicilian House, Southampton Row, W.C.1.

THE death of Mr. J. Hartley Wicksteed on December 16, at seventy-seven years of age, is announced. *Engineering* for December 19 gives some particulars of his career. Probably his inventions which have had most bearing on engineering progress are his vertical single-lever testing machine and his horizontal universal testing machine. Mr. Wicksteed was connected with the Institution of Mechanical Engineers for more than fifty years, and was president in 1903–4. He was one of the first members of council of the Yorkshire College, Leeds, afterwards becoming a life governor of the University; and through this and other local activities he exercised a wide influence. He became a member of the Institution of Civil Engineers in 1889.

BY the death of Dr. Harold Cecil Greenwood a few weeks ago, at thirty-two years of age, British engineering chemistry has lost one of its most promising younger members. Dr. Greenwood was always a careful and accurate worker, and applied that characteristic to even the smallest detail in every problem which he took up. As a result his work was exact; his data on the boiling points of metals, published in 1909, are generally accepted as the most accurate existing upon the subject. During the last three years of his life Dr. Greenwood was engaged on behalf of the Government on an extremely laborious undertaking: the construction of an experimental synthetic ammonia plant for the preparation of ammonia from its elements. In this work his training with Prof. Haber at Karlsruhe stood him in good stead, but it was no easy matter to translate laboratory experimental work to the semi-technical working-plant

model producing 1 kg. per hour of ammonia, desired by the authorities. It was at this stage that his industrial experience with Messrs. Hutton at Sheffield aided him both in the choice of suitable materials and in the proper design of apparatus. No member of Dr. Greenwood's staff had had previous experience with the operation of gases under very high pressures or with the design of suitable plant, yet he not only brought his work to a successful issue, but he also effected the training of the staff in such a way that they could operate the extremely complicated plant unaided. This in itself is a tribute to his technical and executive abilities; and his work on "Industrial Gases," published since his death, is a worthy record of his knowledge of an important department of applied chemistry.

THE loss of that keen geologist, Prof. Joseph Barrell, of Yale, who died at the comparatively early age of fifty on May 4 of last year, will be felt far beyond those who met him and appreciated at first hand his mental energy and accuracy of perception. A sympathetic memorial of Prof. Barrell's work, with a portrait and bibliography, appears in the issue of the *American Journal of Science* for October last, and it is followed by two important papers by him on the theory of isostasy. An obituary notice of Barrell by Prof. Schuchert appears in *Science* (vol. xlix., p. 605, 1919). It is here pointed out that his reasoning powers were applied to the relations of climate to organic evolution, as well as to those problems of earth-structure that he made peculiarly his own.

THE Government of India has appointed a Committee, consisting of European and Indian experts, to inquire into the conditions and prospects of the sugar industry. At present most of the sugar produced is locally consumed in the crude form of "jaggery," but there seems little doubt that if capital and modern methods of manufacture could be introduced India might become one of the great sugar-producing areas in the world. The annual consumption of sugar in India, as elsewhere, has rapidly increased. India until recent years stood first of all the countries in the world in its area under sugar-cane and its estimated yield of cane-sugar, and even now ranks second only to Cuba. Yet it is notorious that the yield both of cane and raw sugar per acre and the available sugar extracted from the cane are undesirably low. In view of the conservative habits of the Indian peasant, the Government, in inducing him to adopt improved methods, has a difficult task to encounter.

AT a conversazione of the Eton College Scientific Society, held on December 15, a presentation from past and present members was made to the retiring president, Mr. W. D. Eggar, who, in returning thanks, referred to the losses which the society had suffered since the last conversazione in 1914, and in particular mentioned the names of W. S. Stewart, A. G. Parsons, and H. G. J. Moseley. Henry Moseley was "in college" with a brilliant band of classical scholars. He obtained his scholarship at Trinity, Oxford, in chemistry and physics, but the only paper which he contributed to the society was on deep-sea fishes. At the 1905 conversazione he demonstrated the simpler properties of those X-rays which afterwards he investigated to such purpose that his name, like that of Robert Boyle, links Eton with a law of Nature. After attending the British Association meeting in Australia, Moseley hurried back to join the Army, and fell in Gallipoli on August 10, 1915. Dr. Leonard Hill, who demonstrated in an amusing and instructive lecture the advantages of oxygen for athletes, deplored the loss to science in Moseley's death. Dr. R. Whytlaw Gray is the new president of the society.

THE council of the Scottish Meteorological Society proposes to hold a series of meetings, mainly in Edinburgh, at which lectures on popular lines will be given or discussions opened on questions of meteorological interest. The first of these lectures has, indeed, already been given in Glasgow by Capt. Franklin, who opened the winter session of the Royal Philosophical Society of Glasgow by an address on "The Study of Meteorology in Schools and Universities." The report of the council, adopted at the annual business meeting on December 19, refers to climatological stations maintained by voluntary observers, and says it has become evident that the country should no longer depend so largely on voluntary effort for a record of important economic factors. It is felt that those who may be in charge of any scheme of reconstruction should regard it as a vital matter that there should be a sufficient skeleton network of stations the permanence of which is guaranteed by some local authority or by some Government Department the interests of which are directly concerned. The president of the society for the ensuing year is Dr. C. G. Knott; vice-presidents, Prof. T. Hudson Beare and Mr. D. A. Stevenson; and hon. secretary, Dr. E. M. Wedderburn.

THE executive committee of the National Union of Scientific Workers has appointed Major A. Church to be whole-time secretary of the union, the appointment to date from January 1, 1920.

A NEW era of prosperity for the Zoological Society of London seems to have dawned. At the last monthly general meeting, held on December 17, it was announced that the number of visitors to the gardens from January 1 to November 30 showed an increase of 653,187 as compared with the previous year, while the money received for admission in the gardens during the same period showed an increase of 22,977*l.* as compared with the corresponding period in 1918.

WE are glad to note that vigorous measures are to be taken to suppress the practice of bird-liming in Lower Egypt. The Ministry of Public Works, Egypt, has just issued a report by Mr. J. Lewis Bonhote setting forth the hideousness of this traffic and the grave results to agriculture which must follow unless it is speedily stopped, for the victims are almost exclusively small, insectivorous birds. In an introduction to the report Major Stanley Flower, Director of the Zoological Service, remarks that in the past, in

every normal year, practically the whole surface of the country was flooded, so that both the insect and rat population was swept away and drowned, with the exception of such comparatively small numbers as could survive by taking refuge in villages, in the tops of banks and trees, and on the desert fringes. The conditions within the last century have changed, and are becoming increasingly favourable for the spread of pests of agriculture. But there are serious difficulties to be overcome in certain districts in enforcing the law, as at Damietta, Fuwa, and Rosetta, owing to the "unpatriotic and uncivilised behaviour" of the local authorities.

MR. T. SHEPPARD has reprinted from the Transactions of the East Riding Antiquarian Society (vol. xxii.) a paper on Danes' Dyke, the remarkable earthwork stretching across the triangular Flamborough headland from north to south. It is certainly much more ancient than the Danish period. Its shape and mode of construction demonstrate that it is not Roman. But in the same area, and associated with the earthwork, are numerous barrows, the implements, weapons, and ornaments found in them belonging to the Bronze age, though they also contain many fine stone implements, the use of which continued into the Bronze age. The results of some excavations made by Major-Gen. Pitt Rivers in October, 1879, are published in the Journal of the Anthropological Institute for 1880.

SIR W. RIDGEWAY describes in the November issue of *Man* a remarkable Irish decorated and socketed bronze axe, of which the provenance is doubtful, but it probably came from Co. Westmeath. The axe, 60 mm. ($2\frac{3}{8}$ in.) long, is remarkable because the maker made a careful scheme of ornamentation for the whole of its surface, dividing it into four compartments by means of four fine curved lines in relief, and adding the main feature, a band or frieze of chevrons, in refined and delicate relief running along the top of each side immediately under the delicate line running below the mouth of the socket. There is no similar specimen in the Irish National Museum or in the British Museum collections, now enriched by that of the late Canon Greenwell, nor does Sir John Evans describe any such in his "Bronze Implements." But Canon Greenwell possessed an Irish socketed axe with elaborate and refined decoration. This agrees fairly well with Sir W. Ridgeway's specimen, which is said to have come from Rathowen, Co. Westmeath, and there is at least some probability that the Ridgeway axe may have been made in that area.

THE progress of boundary delimitation in Europe is the subject of a short article and a useful sketch-map by Mr. A. R. Hinks in the *Geographical Journal* for December (vol. liv., No. 6). The Treaty of Versailles delimited the boundaries of Germany, subject, of course, to the result of the plebiscites in Schleswig, East Prussia, Silesia, and, in fifteen years' time, in the Sarre basin. The Treaty of Saint-Germain-en-Laye delimited the boundaries of Austria subject to the result of the Klagenfurt plebiscite. The new frontier of Italy is not yet fixed in the north-east; the frontier of Hungary is fixed only in the west. Czecho-Slovakia's and Poland's frontiers are incompletely delimited. In Eastern Europe the frontiers are still vague. It is proposed to revise the sketch-map and reissue it from time to time in the *Geographical Journal*.

THE Ordnance Survey decided in 1911 to undertake the levelling of an entirely new network in the British Isles to form the basis for a new series of bench marks and heights shown on the map. Experience has shown that many of the bench marks have altered their heights, either from subsidence or actual displacement; others have disappeared. The instruments and methods decided on for this work were described in a paper on "Precise Levelling" by Major E. O. Henrici read at the Institution of Civil Engineers on December 17. The new lines are laid out so that it is possible to erect special "fundamental" bench marks at intervals of about twenty-five miles. The marks of these will be fixed on solid rock or on concrete founded on rock. These marks have three reference points, one consisting of a metal bolt let into the top of a granite pillar, for general use, and two lower marks which are buried, and are for the use of the Survey only; they will serve in time to come to check the height of the upper mark. The probable error of the difference of height between any two consecutive "fundamental" marks may be about 0·01 ft. Intermediate bench marks take the form of gun-metal plates let into the surface of walls.

IN his new pamphlet ("The Stanton Drew Stones," Bristol, 1s.) Mr. E. Sibree returns to the theme of his former publication ("Stanton Drew: A Calendar in Stone"), treating it in greater detail and with an abundant wealth of literary scholarship and interesting folk-lore. The circles of 30, 12, and 8 stones respectively are referred to the days of the month, the months of the year, and the years of the Venus cycle of intercalation. Eight years of 12 months, each of 30 days, contain 2880 days; if to these are added 12+30 days we get 2922 days, very nearly eight solar years. Mr. Sibree shows that the same number is obtained from the Carnac stone calendar in Brittany. He draws the conclusion that the Stanton Drew calendar was erected by Romans or by Romanised Britons in about the fifth century. Some confirmation is afforded by the fact that the diameters of the circles are 375, 150, and 100 Roman feet respectively, proportional to the numbers of stones in the circles, and by the presence of the Guild of Calendaries at Bristol in about A.D. 700. Much of the lore of Merlin and of the Welsh mythology is invoked to support this conclusion. It must be urged, however, that the lateness of the author's date is surprising. The geometrical interpretation of the construction of the circles is very artificial and too complicated to be accepted as the intention of the erectors; in any case, it is really irrelevant to the main theme of Mr. Sibree's pamphlet.

MR. A. L. SHEATHER describes a malaria-like parasite found in the blood of an Indian buffalo. The animal suffered from irregular attacks of fever and anæmia, and eventually died. The parasites occurred

in considerable numbers and in three forms—small, large, and dividing (Agricultural Research Institute, Pusa, Bulletin No. 90). Malaria-like parasites in the blood of ruminants seem to have been recorded only by Bruce, who found two antelopes infected in Nyasaland in 1913.

IN the recently issued fascicle iv. of "Contributions à la faune des Indes néerlandaises" (vol. i.), published by the Instituts scientifiques de Buitenzorg, Dr. Paul van Oye gives an account of the Chætognatha found in fifty-one samples of plankton taken off the north coast of Java. He describes five new species of Sagitta and one of Krohnitta, and founds a new genus Zahonya. Details are given of the horizontal distribution of the various species. Dr. A. L. J. Sunier has examined the collection of Stomatopoda in the fishery station and in the museum at Buitenzorg. The specimens prove to belong to known species of Squilla, Pseudosquilla, Odontodactylus, and Gonodactylus. Notes are given on seventeen species, the known geographical range of several of which is considerably extended.

IN the paragraph in these columns on September 25 (p. 78) referring to a paper by Mr. E. W. Vredenburg on "Observations on the Shells of the Family Doliidæ," the statement that "it appears that the genus Dolium is not known in formations older than the Oligocene" is in need of correction. Mr. E. A. Martin writes to point out that a Cretaceous Dolium is mentioned in Mantell's "Medals of Creation" and in the same author's "Geology of Sussex" (1822, p. 196). This was described and figured as *Dolium nodosum* by Sowerby in 1825 ("Mineral Conchology," vol. v., p. 34, pls. 426, 427). The figures represent casts of a large species of this genus. An analogous, if not identical, species of Dolium is recorded by W. C. Williamson from the Cretaceous formation of Mount Gebeel Suneen, part of the Lebanon range, immediately above Beyrout (Proc. Geol. Soc. Lond., iii., 1840, p. 291).

DR. NATHAN MUTCH describes in the Journal of the Royal Microscopical Society (pt. 3, September, 1919, p. 221) a comparatively simple procedure for the isolation of a single bacterial cell. It consists essentially in making a very dilute emulsion of the culture and transferring a minute drop of this to a sterile cover-glass, which is quickly mounted on a cell so as to form a hanging-drop preparation. A ring of filter-paper moistened with saline solution is placed on the bottom of the cell, and serves both to prevent evaporation from, and addition of moisture to, the hanging drop, which thus maintains a constant size. The preparation is then examined microscopically, and if a single cell only is found to be present, a drop of melted sterile agar is added to the drop on the cover-glass, the preparation remounted on the cell, incubated, and a growth is thus obtained.

WE learn, from *California Fish and Game*, vol. v., No. 4, that in 1919, for the first time in several years, squid were caught in abundance at Montery, California. Three Chinese firms have dried, in the past season, about 1,772,000 lb. of this mollusc. Three tons of wet furnish one ton of dried squid. Practically the whole of the harvest was sent to China. But, apparently by way of experiment, a small percentage of the catch was canned, while some was put upon the market in a fresh state, and is, it would seem, slowly winning favour as a table delicacy. Squid tentacles are said to rival the oyster in flavour. The kelp industry, which was started during the war to furnish potash, seems, from this number, to have come to an end. But it is hoped that the plant will be re-started on a paying basis by the sale of certain by-products which are obtainable during the process of extracting the potash. No hint, however, is given as to the nature of these promising substances.

THE *Journal of Agricultural Research* for October 15 contains two interesting contributions to the study of plant nutrition. By determining the composition of barley at successive stages of its growth in soil, Mr. J. S. Burd demonstrated considerable losses of potassium and nitrogen from the plant at the beginning of ear-formation, at which period the water-extract of the soil has a minimum concentration. The author considers that the most important condition of the soil solution for a high yield is an adequate supply of nutrient elements during the first half of the growth-period; subsequent high concentration is unnecessary, and may be undesirable. Similar results were obtained by Mr. D. R. Hoagland in carefully controlled sand and water cultures. Marked absorption of all nutritive elements occurred throughout growth if suitable concentrations of the medium were continuously maintained, but the absorption in the later stages of growth led to no important increase in yield. Attention is directed to the necessity of clearly distinguishing between the concentration and the total supply of essential elements in the nutrient solution, since rapid absorption by the plant may produce considerable alterations in the composition of the solutions.

A REPORT of the Meteorological Committee for the year ended March 31, 1919, has recently been issued. This is the first report since the Armistice, and much interesting information is given in it. Immense strides have been made in meteorology, and the Meteorological Office has expanded accordingly, dependent on the necessities of the war. Whereas the sum available, including many costs for the Services, in the year 1913–14 was 29,380*l.*, in 1918–19 it was 66,371*l.* A much greater demand was made on the office for meteorological instruments, and for forecasts of all descriptions, including the upper air. The marine division, on the other hand, which is dependent for its information on the Royal Navy and mercantile marine, experienced a great falling off in the number of documents received from observers at sea, the documents numbering 2738 in the year 1913–14 and only 43 in 1918–19. Throughout the war there was great activity in the supply of data to the Army, Navy, and Air Service, and the work commonly undertaken in times of peace was greatly augmented, although most of the information was considered private and was withheld from the general public. The restrictions upon the circulation of meteorological information were removed after the signing of the Armistice.

Reports for the several branches of the office show the variety and extended work now undertaken. Any future report will presumably be made through the Air Ministry, to which the Meteorological Office is now responsible.

EXPERIMENTS have been carried out by Prof. Garelli, of Turin, on behalf of the Italian Government, with the view of extracting nitrate of ammonia from surplus stocks of explosives. According to *La Nature* of November 29 last, the explosive mixture is placed in special receptacles, a fixed quantity of water added, and the whole allowed to stand. A dense solution of nitrate of ammonia is then formed, which is separated by decantation. Powdered peat is then added to this solution, and after mixing and drying the product thus obtained it becomes a species of manure which is called "nitric peat." This material, which has the appearance of a blackish powder, has the following composition:—Water, 17·8 per cent.; ash, 18·8 per cent.; nitrate of ammonia, 42·8 per cent.; and organic matter, 20·6 per cent. Tests for ascertaining its value as a fertiliser have been carried out in the Alba district of Italy, and the results show that the action of this fertiliser is nearly equal to that of nitrate of soda.

DR. A. E. H. TUTTON has recently published in the Proceedings of the Royal Society (A, vol. xcvi., pp. 156–84) the results of an exhaustive study of the crystallographic properties of the monoclinic double selenates of the cobalt group, $R_2Co(SeO_4)_2,6H_2O$, where R stands for potassium, rubidium, cæsium, and ammonium successively. Only the potassium and ammonium salts of the group had previously been studied. The results fulfilled expectation, and fully accorded with those obtained for the zinc, magnesium, nickel, and iron groups, and for the eight known groups of the analogous double sulphates. The dominating facts brought out are, first, the progressive character of all the crystallographic and physical properties following the alkali metals concerned, potassium, rubidium, and cæsium; and, secondly, the almost perfect isostructure of the crystals of the ammonium and rubidium salts of the group.

THE Australian Institute of Science and Industry has published at Melbourne a pamphlet on "Engineering Standardisation," by Mr. Gerald Lightfoot. The objects of standardisation in cheapening manufacture and reducing maintenance charges and stocks, and in securing interchangeability of parts, are discussed. The British Standards Association is described, and under its influence other similar bodies are being formed in various countries. It is argued that if Australia neglects to take action, it will be impracticable to develop her engineering industries at the same level as in other countries. The institute desires to carry out research work on lines similar to those in the case of the U.S. Bureau of Standards and the National Physical Laboratory. The outline of a scheme for the formation of a Commonwealth Engineering Standards Association is given. It is mentioned that there is a multiplicity of voltages in electrical supply in Australia, and that merchants have to stock lamps for about twenty different voltages.

VOL. XIII. of the Transactions of the Rochdale Literary and Scientific Society contains the papers that have been read before the society during the years 1917–19. These papers, some fifteen in number, are entirely devoted to local subjects, and are mainly concerned with the history of the town and its institutions. There is a short article by Mr. E. L. Taylor on the Rochdale Grammar School (an old foundation dating back to 1564), two papers on the old Rochdale roads by Dr. Ashworth and Mr. A. P. Wadsworth, an annotated list of Querns found in the Rochdale district by Mr. J. L. Maxim, and a topical contribution by Mr. G. E. Leach on the connection of Rochdale with Peterloo in 1819. Of immediate interest to scientific readers we may note the interesting presidential address by Dr. Ashworth, in which he gives a brief but clear statement of the great and important part which Lancashire men and institutions have played in the striking advances which have taken place in electrical science during the last hundred years. The Rev. T. A. Jefferies contributes a short but suggestive paper on the natural transformations in the vegetation of Blackstone Edge, in which he traces the life-cycle of its plant associations. Dr. Ashworth's paper on atmospheric pollution in Rochdale provides the local authorities with a valuable mass of facts on which to base legislative action to mitigate the evils of smoke, unfortunately inevitable in large industrial areas. Altogether, the volume is an excellent example of the kind of research work, both historical and scientific, which it is the peculiar province of local societies to undertake.

A VOLUME devoted to the "Life and Letters of Silvanus Phillips Thompson" has been prepared by his wife and his daughter, Miss Helen G. Thompson, and will be published by Mr. T. Fisher Unwin in the spring. Many of the letters relate experiences on journeys abroad, some record adventures of the antiquarian in pursuit of early scientific literature, while others tell of battles for truth in some field or other. A few chapters deal solely with Thompson's scientific and public work, and contain appreciations of his books and original papers. Throughout the work there are many indirect testimonies to the warmth of personal regard which the frank geniality of his nature won for him and to the influences he exerted on the lives of those he met.

Messrs. George Bell and Sons, Ltd., will publish almost immediately "The Year-book of the Universities of the Empire" for 1920, edited by W. H. Dawson. The latest list of the *Cambridge University Press* includes:—The late Prof. J. H. Poynting's "Collected Scientific Papers," edited by Dr. G. A. Shakespear and G. Barlow, with biographical and critical notices by Sir Oliver Lodge, Sir Joseph Larmor, Sir J. J. Thomson, and Dr. G. A. Shakespear; "An Introduction to the Study of Cytology: An Outline of the Main Facts of Cytology for Advanced Students," Prof. L. Doncaster; "The Foundations of Einstein's Theory of Gravitation," E. Freundlich, translated by H. L. Brose; "A History of English Philosophy," Dr. W. R. Sorley; "Discovery

in Greek Lands," F. H. Marshall; and "Life and Labour in the 19th Century," C. R. Fay. *Messrs. Constable and Co., Ltd.*, announce "Montessori Experiments," Miss Blackburn. Prof. Patrick Geddes has written a volume, which *Messrs. Longmans and Co.* will issue shortly, on the life and work of Sir Jagadis Chandra Bose, the founder of the Bose Research Institute in Calcutta.

OUR ASTRONOMICAL COLUMN.

FIREBALL ON DECEMBER 25.—A brilliant fireball was visible on Christmas night at 10h. 21m. at Bristol. It must have very much exceeded Venus in lustre, for it gave a flash which illumined the whole sky, and in that section of its flight where the greatest outburst occurred it left a streak about 3° long for 40 seconds. The apparent path was from 115°+34° to 105½°+1°. The motion was rather swift, the course of about 35° being traversed in 2 seconds. The radiant point is doubtful; it may have been at 165°+73°, 219°+75°, 245°+72°, or 261°+62°. If the second is the correct position, the meteor may quite possibly be considered to have been a fragment of Mechain-Tuttle's comet, which has a period of about 13½ years. Further observations of the object would be valuable, and should be sent to Mr. W. F. Denning, 44 Egerton Road, Bristol.

COMETS.—The following continuation of the ephemeris of Finlay's comet is for Greenwich midnight, from the elements in Lick Bull. 325 :—

		R.A.	N. Decl.	Log r	Log Δ
		h. m. s.	° ′		
Jan.	2 ...	3 3 35	21 47	0·1703	9·8160
	6 ...	3 12 57	22 24	0·1806	9·8510
	10 ...	3 22 24	22 58	0·1911	9·8849
	14 ...	3 31 21	23 27	0·2013	9·9173
	18 ...	3 40 9	23 55	0·2114	9·9485

The comet will traverse the Pleiades on January 18.

It is calculated that Holmes's comet passed perihelion about November 30, and a search ephemeris was published. The comet is probably too faint to give much hope of its recovery. It has not been seen for two revolutions.

RADIATION PRESSURE.—The *Astrophysical Journal* for October last contains an article by Mr. Megh Nad Saha in which the opinion is expressed that the quantum theory of light will explain the repulsion of particles much more minute than those the dimensions of which are of the order of a wave-length. In the undulatory theory the repulsion is a maximum for particles of that order of magnitude, and becomes practically zero for those of the dimensions of molecules. Mr. Saha quotes the results of spectrum analysis of comets' tails, and some laboratory experiments by Lebedew (*Ann. der Physik*, 1910), for the fact that gaseous molecules actually do suffer repulsion by radiation pressure, which he considers an argument in favour of the quantum theory.

Assuming that a pulse of light gives all its momentum to a hydrogen atom, the velocity imparted to the latter by each "kick" would be 60 cm./sec. Some calculations are given, from which the author deduces that by repeated "kicks" the atom might acquire a velocity of 6×10^7 cm./sec., which has sometimes been observed in the solar prominences.

THE ORION NEBULA.—We lately noted Dr. Bergstrand's estimate of the parallax of this object, 0·0078″. Prof. W. H. Pickering (Pubns. Ast. Soc. Pac., April, 1919) contends for the value 0·0020″. This is deduced from assumptions of the absolute magnitudes of a number of faint stars which appear to be associated with the nebula. By comparing their photographic with their visual magnitudes, he concludes that their spectral type is A or B, whence their absolute magnitude is unlikely to be very low. But this involves the conclusion that the brighter stars in Orion are supergiants. Rigel in particular would have 87,000 times the luminosity of the sun. But perhaps it is nearly as easy to accept this as the value 5000 times the sun, which results from Dr. Bergstrand's parallax. Prof. Pickering estimates for the masses of the faint B7 stars in the nebula only four times that of Jupiter, using his parallax. With Kapteyn's parallax 0·0054″, the mass would be one-twentieth of this. Either value seems far too small for a body to attain the temperature necessary to shine as a B star.

SPHERICAL SHELL CRYSTALS IN ALLOYS.

AT the autumn meeting of the Institute of Metals recently held in Sheffield, Dr. J. E. Stead presented an account of his investigations on some ternary alloys of tin, antimony, and arsenic, one of which was noticed by him to crystallise in a most unusual and remarkable way.

Having found that the alloys of antimony and tin crystallise in what appear to be cubic crystals, and those of tin and arsenic in rhombohedral flat plates, he made trials with the object of finding how the metals would arrange themselves when the three elements were fused together and the melt allowed to cool. The results obtained were astonishing, for the crystals found in the matrix had the form of incomplete spherical shells, the radii of which were small or great, according to the time allowed for development. With rapid freezing the radii were less than half a millimetre; when it was protracted for one hour they were 5 mm. or more. The most perfect structural arrangement of the crystals was obtained in an alloy containing from 70–85 per cent. of tin, 25–15 per cent. of antimony, and 4–5 per cent. of arsenic. Whether cooled slowly or quickly, the polished surface of the alloys, after dissolving away the matrix, is very suitable for printing blocks, since the hard crystals stand out in bold relief (see Fig. 1). The alloys are very brittle, and the fracture was found to travel midway along the shell walls. An alloy containing tin 70 per cent., antimony 25 per cent., and arsenic 5 per cent. gave the following arrests on cooling :—

(1) First separation of crystals ... 440° C.
(2) Retardation in cooling between 325° and 320° C.
(3) Solidification of the eutectic ... 244·9° C.

The last-named temperature agrees closely with that of the eutectic of the tin-antimony alloys. The conclusion is, therefore, warranted that the eutectic cannot contain more than a trace of arsenic, an inference confirmed by experiment. It was afterwards shown by analysis that the primary crystals contain a maximum amount of arsenic, and that, as crystallisation proceeds, the deposits contain less and less of this metal.

A large number of ternary alloys were prepared. It was found that, while it required 2·5 per cent. of arsenic in the presence of 25 per cent. of antimony to produce slightly curved crystals, 0·5 per cent. of arsenic in the presence of 3·75 per cent. of antimony yielded curved segments in the upper layers. In an alloy containing 1·65 per cent. of arsenic, 14·35 per cent. of antimony, and 85 per cent. of tin, spherical crystals were found in the top layers, below these smaller seg-

ments, under the latter cuboidal crystals, while the lowest stratum consisted of the eutectic. It was evident that the compound richest in arsenic was the first to freeze and floated upwards to the surface. As yet the analyses have given no decisive results as to the composition of these shells. Further details have been promised by Dr. Stead, and will be published in due course.

FIG. 1 (Nature-print).

In the instance just quoted, four distinct stages of crystal growth can be observed. When, however, the proportion of antimony is between 20 and 25 per cent. and that of arsenic about 5 per cent., the primary crystals are distributed evenly through the whole alloy and there is no stratification.

That the primary crystals which form in such alloys are spherical shell crystals was shown by chilling

FIG. 2 (Photograph).

them just below the first thermal arrest. Fig. 2 depicts the structure after this operation. Sections of the shells are visible which are smooth on the concave, but slightly broken on the convex, side, due possibly to the stresses set up during quenching. With somewhat slower cooling, as shown in Fig. 3, both surfaces of the shells are seen to be smooth. That these are composite and contain a hard primary core was shown by grinding and polishing experiments.

In the latter part of his paper Dr. Stead quotes the opinion of Mr. L. J. Spencer, to whom specimens of the alloy containing spherical shells were submitted for his opinion, and who furnished Dr. Stead with important data regarding the curvature of crystals in minerals. Mr. Spencer's complete notes on the subject have been communicated to the Mineralogical Society. In them he refers to various instances of apparent curvature classified under these headings:—

(1) Curved crystallites; (2) capillary habit; (3) aggregations of crystals; (4) interfacial oscillations; (5) vicinal faces; (6) bent crystals; (7) twisted crystals; and (8) cylindrical and spherical crystals.

It would appear that, according to his view, the last-named constitutes the closest analogy to the alloy in question. "The mineral kylindrite is a sulphur salt of tin, lead, antimony, and iron. . . . It has the appearance of consisting of tightly wound rolls of foil with a smooth surface and a brilliant metallic lustre. The ore consists of large numbers of these rolls, with a more or less radial grouping. . . . The rolls have a diameter of a few millimetres up to one centimetre,

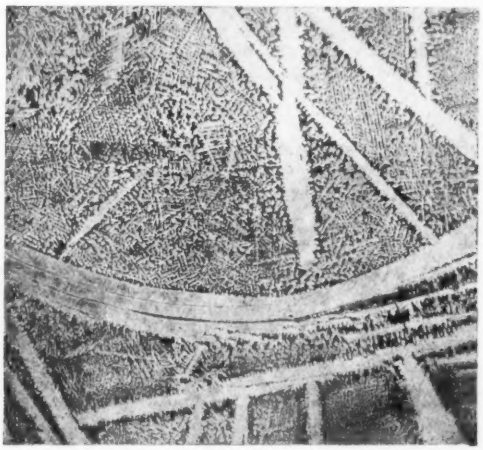

FIG. 3 (Photograph).

and reach a length of three to four centimetres. They flake off in concentric cylindrical shells with all the appearance of a perfect cleavage, very similar to that of the allied minerals, franckeite and teallite. These cylindrically curved cleavage flakes are perfectly bright and smooth and show no visible signs of being built up of smaller elements. Spherical aggregates of crystals possessing a perfect cleavage are, however, met with, but here a radial grouping is much more common than a concentric arrangement. Examples of radiating spherical aggregates of lamellar crystals with platy cleavages are pyrophyllite, zeophyllite, gyrolite, faröelite, tyrolite, etc."

With reference to the cases of curvature in mineral crystals thus referred to, Dr. Stead contends that none approach in character or form the spherical shell crystals obtained in his ternary alloys; that radial crystallisation round a nucleus is common in minerals, but the spherical form finally produced is an aggregation of many crystals, and not a single crystal; and that kylindrite consists of a number of cylindrical crystals which have formed round a central

axis and are not independent cylinders. He states that no case is known to him in which the idiomorphic forms of the crystals are segments of spherical shells which have crystallised out of a liquid except in the ternary alloys referred to. The reason why idiomorphic shell crystals develop under such conditions and the laws which govern their formation await further research. Meantime, Prof. Bragg, to whom some of the separated crystals have been sent, has kindly promised to study them. H. C. H. C.

FORECASTING FROSTS.

IN most countries during the spring, and to a lesser extent in the autumn, there are periods in which the meteorological conditions result in a frost. Leaving out of the question spells of cold weather, the prediction of which is the concern of a Meteorological Service, there remains the possibility of local frosts in isolated districts, occurring on clear, windless nights and lasting for a portion of the night and early morning. These frosts are capable of doing great damage to fruit-trees, etc., and the possibility of forecasting them in time for the fruit-growers to take precautions is of interest and importance.

It has long been recognised that local cooling of the soil can be largely prevented by a smoke pall produced by the burning of damp materials such as straw. Boussingault ("Economie Rurale," Paris, 1844) discusses this, and records an observation on the point by Pliny. In America definite systems of frost prediction have been in operation for some years, and practical methods have been evolved by which the grower can economically combat the danger to his crops. A study of these preventive measures is instructive in showing that several causes are concerned in producing a frost. The methods are varied. Leaving out those which attempt to delay the flowering-time until the danger period is past, they fall into four main classes:—(1) Increasing the water-content of the area (spraying or flooding); (2) "smudge" burning (damp smoke from wet straw, etc.); (3) temporary roofing; and (4) dry heating. The last method supplies additional heat mainly; the other three are largely indirect, and aim at reducing the rate of temperature fall either by increasing the heat capacity of the soil by the added water or by restricting the radiation from the soil.

Up to the present no complete correlation has been made of frost in any particular locality and its causes. For this purpose an examination by statistical methods of a series of continuous observations (of the automatic recording type) of meteorological factors is needed. The published papers deal usually with one factor, such as dew-point or air temperature, and the number of daily observations made is small. This is, no doubt, due to the necessity of keeping the cost of apparatus and working as low as possible for the sake of the growers. However, a general idea of the factors concerned can be obtained from a broad survey of the various papers.

The effect of an overcast sky on air temperatures near the ground has been studied by Hellman (*Preuss. Akad. Wiss.*, Berlin, 38, 1918, p. 806), who on clear nights found an exponential decrease of temperature with height, the average difference from ground-level to a height of 50 cm. being 3·7° C. An increase of cloudiness by 1° of scale (0=clear, 10=overcast) diminished this difference by at least ⅛° C. There was no temperature gradient when the sky was overcast, while windy and rainy weather resulted in a slight reversal of the gradient. Schubert (*Met. Ztsch.*, 32, 1915, p. 343) considers that during the last half of the night the fall of temperature is relatively greater with dry than with moist air, owing to the formation of dew, and frost from the latter resulting in latent heat being set free by the condensation. The presence of water-vapour in the atmosphere also retards the radiation cooling of the soil.

J. Warren Smith (*U.S. Monthly Weather Review*, 42, 1914, p. 573; 45, 1917, p. 402) has examined the accuracy of various methods of temperature prediction. The first, and simplest, is to subtract from the maximum temperature of the day the known average fall in temperature on clear, still afternoons and evenings for the appropriate period of the year. This temperature range varies in different months, but is remarkably uniform under similar topographical conditions and at similar seasons of the year. It has been used by Church (Nevada Station Report, 1915, p. 46).

The second method is due to Smith, and involves two temperature readings daily. Smith discovered that the daily temperature curves showed marked similarity in periods of calm, clear weather when a high-pressure system was centred over the district and conditions were favourable for strong insolation during the day and free radiation at night. For these curves the half-way point in the temperature fall from the maximum of one day to the minimum of the next morning (the "median") occurred at very nearly the same time. Hence a forecast of the probable minimum can be made by subtracting from the maximum the temperature shown at the time previously ascertained to be that of the median, and then subtracting this difference in turn from the observed median temperature. The values thus obtained agreed much more closely with the observed minima than those given by the original dew-point method, which is mentioned immediately below.

The third method, as developed by Smith, is an elaboration of the dew-point determination. This, as used by Hazen (Minn. Expt. Sta. Bull. 12, 1890), and by O'Gara (U.S. Farmers' Bull. No. 401, 1915), consists simply in determining the dew-point in the early evening (6–10 p.m.), and assumes the dew-point temperature will be the probable minimum temperature reached. Smith found that the prediction could be made much more accurately if the relative humidity of the atmosphere was also determined, and he used the correlation method to show that with high relative humidity the minimum temperature falls below the determined dew-point, while with low relative humidity the reverse is true. A satisfactory equation expressing this relation was obtained,

$$Y = 18{\cdot}314 - 0{\cdot}39R,$$

where R = relative humidity in the evening, and Y is departure of minimum temperature of the following morning from evening dew-point. A determination of R gives the value of Y, which added to (or subtracted from) the dew-point gives the probable minimum temperature to be expected. The numerical terms in the equation differ for different localities.

Recently T. B. Franklin (Proc. Roy. Soc. Edin., 39, 1919, p. 120) has published some observations on the cooling of the soil at night, with special reference to late spring frosts, and has arrived at a number of important conclusions, which will help considerably in developing methods for forecasting the minimum surface-soil temperature in this country. As a result of observations of temperatures in the air, on the soil, and at a depth of 4 in., Franklin concludes that a prediction of frost depends on assessing the value of:—(1) Average relative humidity during the night; (2) the temperature of a given depth (4 in.) at the time of surface minimum temperature; (3) the conductivity of the layer between the assigned depth

and the surface; and (4) the difference between the surface-soil minimum and that of the air above it. These determinations are necessary because:—(i) The radiation from the soil on calm, clear nights is a function of the relative humidity (A. Ångström, Smithsonian Misc. Coll., 65 No. 3); (ii) the radiation from the soil can be accounted for in balancing the upward conduction and the latent heat of freezing, the residue only cooling the soil; and (iii) the temperature of the surface soil rapidly falls sufficiently below the temperature of the 4-in. depth to make the conduction from this depth balance the radiation; after this the surface temperature falls no faster than that of the 4-in. depth.

Franklin has also noted rapid changes in underground temperature (6-in. depth) after heavy rain. This he attributes to the receding water drawing hot or cold air into the soil, but it is scarcely possible that the volume of air thus drawn in could supply or abstract sufficient heat to account for the observed differences. These latter are in the direction which would be expected from the time of the day when the readings were taken; and while the re-aëration of the soil may have slightly increased the temperature changes, it is unlikely that it had a predominating influence. B. A. KEEN.

LUBRICATION AND LUBRICANTS.

THE meeting of the Physical Society held on November 28 was devoted to a discussion on the subject of lubrication, suggested by a paper on "Oiliness and Lubrication" by Mr. R. M. Deeley, sent by the Committee on Lubrication. Other contributors included Dr. Stanton, Principal Skinner, Messrs. W. B. Hardy, Dorman, Southcombe, Martin, Archbutt, Edser, and Dr. H. S. Allen.

In the consideration of lubrication problems a clear distinction must be made between two prevailing conditions, viz.: (1) Those in which the solid surfaces are completely separated by a film of oil, as occurs in the lubrication of cylindrical journals and their bearings working under moderate pressures, revolving at high speed, and supplied with abundance of oil; and (2) those in which, owing to the shape or condition of the surfaces, the kind of motion, high bearing pressure, low speed, or an inadequate supply of oil, the oil-film cannot form completely, or becomes broken, and the solid surfaces come into contact. In (1) the friction is entirely due to the viscosity of the oil, as proved by Beauchamp Tower and Osborne Reynolds. Engineers have Reynolds's theory to guide them in the design of bearings so as to secure fluid friction, and it is possible by determining the viscosity and chemical characteristics of an oil to form a sound opinion as to its suitability to meet the required conditions. In (2) the circumstances are quite different. Lubricating value is then found to depend upon some property which is quite distinct from viscosity, and has been called "oiliness."

In opening the discussion Dr. Stanton referred to experiments recently made at the National Physical Laboratory for the Lubrication Committee with the Lanchester worm-gear testing machine, in which working pressures of several tons per square inch are developed, showing that in the case of all the mineral oils tested the lubrication at a certain temperature suddenly became imperfect, the friction irregular, and the efficiency of the gear fell off. With fixed oils no such "breaking-down" point was observed under the conditions of the tests, and it was found that by adding quite a small percentage of fatty oil to a mineral oil the breaking-down point, though not obliterated, occurred at a higher temperature.

Mr. Deeley described and exhibited a small hand-driven machine which he had invented for the purpose of measuring the oiliness of lubricants under conditions of metallic contact. Three flat-ended metal studs, each 5/32″ in diameter, secured concentrically as feet to a metal disc, rested upon another metal disc which could be slowly rotated. The upper disc could be weighted as desired, and actuated a spindle to which a spiral spring and a recording finger were attached. The lower disc, when rotated, carried the studs and upper disc with it by friction until the stress in the spring caused the surfaces to slip, when the pointer gave the frictional resistance, oscillations being damped by gearing the spring and pointer to a train of wheels. Experiments made with this machine showed that the static friction depended upon the nature of the metal surfaces in contact as well as upon the oil, and the fatty oils which in practice are found to be the best lubricants gave lower static coefficients than the mineral oils. Mr. Deeley's view is that the oil, or some constituent of it, enters into physico-chemical union with the comparatively rigid metallic surface, forming a composite film having the yielding nature of velvet-pile, and that the best lubricants are those which produce the most easily sheared contact films.

Dr. Allen directed attention to the important work of Irving Langmuir on surface films, and suggested that the property of "oiliness" depends upon the chemical forces called into play between the active part of the oil molecule and the solid surface of the bearing, and not only on the nature of the lubricant, but also on that of the solid surfaces with which the liquid is brought into contact.

Mr. W. B. Hardy referred to the work carried on by his son and himself, and discussed by them in the *Philosophical Magazine* of July last. In the apparatus they used there was only one point of contact between the solid surfaces, which consisted at first of a curved watch-glass on a flat glass plate, and latterly of similarly shaped surfaces of bismuth. The force measured was that necessary to cause the curved surface to slide over the plate when lubricated by the films formed by individual chemical substances representative of various groups of chemical compounds. The authors concluded that the true function of a lubricant was to reduce the energy of the surface, and thereby to reduce the capacity for cohesion and the resistance to slip when two composite surfaces are applied one to the other. This, in the opinion of the present writer, is the conclusion to which all recent work leads, and the problem before the chemist is to determine in what manner the molecular structure of the chemical compounds in lubricants determines their "oiliness."

The practical side of the problem cannot, however, be neglected, and it is necessary to experiment with commercial lubricants acting between such dissimilar metal surfaces as are used in the construction of machines, in order to obtain the information which engineers require to guide them in the lubrication of machinery. Mr. Southcombe's observation that the interfacial tension between oil and water and oil and mercury is much higher with mineral oils than with fatty oils, and that the addition of a very little free oleic acid to a mineral oil greatly lowers the surface tension, is of great importance. It appears that by adding 1 per cent. of free fatty acid to a mineral oil the lubricating power is increased as much as by adding a very much larger percentage of fatty oil. The emulsifying properties can also be materially modified by the addition of fatty acids. L. A.

ADULT EDUCATION.

THE Final Report of the Adult Education Committee of the Ministry of Reconstruction (Cd. 321, 1s. 9d.), appointed in July, 1917, as a Sub-Committee of the Reconstruction Committee, over which the Prime Minister presided, but afterwards, on the establishment of the Ministry of Reconstruction, as a Committee of the Department, has been issued and presented to the Prime Minister, in the absence of a Minister of Reconstruction to succeed Sir Auckland Geddes. It is a most informing and suggestive document, and has been preceded by three interim reports dealing respectively with industrial and social conditions in relation to adult education, and suggesting drastic reforms, both industrial and social; education in the Army; and libraries and museums, in which it is insisted that a much closer relationship and co-operation should be arranged with other branches of educational work, even to the extent of the transfer of their administration to the local education authorities.

The Committee was presided over by the Master of Balliol, who has prefaced the Report by a most illuminating covering letter addressed to the Prime Minister. The Committee comprised scholars, employers, trade unionists, and representatives of the Workers' Educational Association, and included men and women fully conversant with the needs of working people and others, and familiar with the work of the various educational organisations, both public and private. Its terms of reference were :—"To consider the provision for, and possibilities of, adult education (other than technical or vocational) in Great Britain, and to make recommendations." The scope of the inquiry necessarily covers a wide field, but it has been fully considered in its various aspects, and comprises a history and general review of adult education since 1800; standards and methods in adult education and its weaknesses and possibilities; the relation of the State and local authorities and of the higher institutions of learning to adult education; the supply of teachers; the development of adult education in rural areas; the relation of technical to humane studies; the organisation and finance of adult education; and concludes with certain valuable recommendations for its effective establishment.

The Report covers 178 pages, and, as is the case with the interim reports, is unanimous. It is followed by four important appendices, the first of which reviews respectively and at great length the present provision of the means and facilities of adult education; the part played therein by the local authorities; the universities in respect of lecture extension courses, and especially of tutorial classes; voluntary agencies such as the Workers' Educational Association; the colleges for working people, including the London Working Men's College and the Ruskin and Labour Colleges at Oxford; the educational work of residential settlements like Toynbee Hall and the Passmore Edwards Settlements, and of non-residential such as Swarthmore, Leeds; the Gilchrist Trust, the National Home Reading Union, the co-operative movement, and other activities of literary and scientific societies; war-time developments; and, finally, adult education abroad. The further appendices deal with university education in London and in Wales, the report of the Committee on the position of natural science and that of modern languages in our educational system. The appendices, which are replete with statistics and fertile in suggestion, cover 200 pages of the Final Report.

The Report lays down as an absolute condition of future civilised progress that education, taken in its true sense, is the basis and postulate of all urgent problems of reform, whether they refer to domestic questions such as those of nationalisation, the claims of Labour to better conditions of life, the position of woman, the subject of a Second Chamber, and social matters such as those of drink and prostitution, or to political questions dealing with the Imperial position in relation to the self-governing Dominions or to India and Egypt, or to the international problems involved in the redrawing of the map of Europe on sound lines of nationality with due regard to the claims of racial and religious minorities.

These serious and urgent problems will not find a speedy and wise solution until we have an educated and enlightened public. There is abundant evidence, in the opinion of the Committee, of the demand of the adult members of the public for the means of a humane and liberal education, which shall include literature, modern languages, local and general history, economics, art, and the natural sciences. There is latent in the mass of the people a capacity, far from being recognised as it should be, to rise to the fundamental conceptions of great issues and to face the difficulties incident to their realisation.

The Committee has based its main conclusions on the following propositions :—The main purpose of education is to fit a man or woman for life as a member of a civilised community, and so the education of the adult must proceed on the lines of successive periods in his education: the family, the school, the trade union or the profession, and the locality, which are all successive stages, and reach their fullness in the life of the community; and whilst each part of the process must be related to its appropriate stage, the goal of all education must be citizenship, viewed in relation to both rights and duties on the part of the individual as a member of the community. This is the *raison d'être* of the need for facilities for education and training

Adult education must not be regarded as a luxury for a few exceptional persons, or as a thing which concerns a short span of early manhood, but as an object of permanent national necessity, as an inseparable aspect of citizenship, and be therefore universal and lifelong, spread systematically and uniformly over the whole community in its own interest and as a duty to its members. All possible encouragement should be given to voluntary organisation, so that there may be freedom of experiment and that their work may find its appropriate place and opportunity of development in the national educational system.

The tutorial class methods of instruction are unreservedly praised in the Report, and, in order that the higher institutions of learning shall be enabled to take their full share in their development, the demand is made that the State and the local authorities shall place more abundant resources at their disposal, so that their staffs of teachers may be largely increased. In the present crisis of the nation's affairs is found the chief and abiding reason for the speedy adoption of the Committee's recommendations.

AN OBSCURE DISEASE, ENCEPHALITIS LETHARGICA.[1]

ABOUT two years ago reports began to appear concerning a "new" acute general disease associated with a condition of apathy and drowsiness which passed into lethargy. Other striking features were progressive muscular weakness and paralysis of various cranial nerves, leading especially to squint. The prevailing abnormal conditions of life and living

[1] Report of an Inquiry into an Obscure Disease, *Encephalitis lethargica*. Local Government Board Reports (New Series, No. 121), 1918.

caused suspicion at first to fall on articles of diet. Thus some observers were struck by a similarity to cases of botulism, a disease due to the poisons of a bacillus which can flourish in foodstuffs kept out of contact with air, as when meat or vegetables are immersed in a weak pickle. Others suggested that some essential accessory factor had been lacking in the diet, so leading to a "deficiency" disease, perhaps analogous to beri-beri, in which nervous symptoms are prominent from affection of the peripheral nerves. But the wide area over which cases were distributed, and the rarity with which more than a single member was attacked in any one family, almost excluded such theories of causation.

Further clinical investigation, and especially pathological examination, established the close resemblance between the new disease and the well-known condition, acute poliomyelitis or infantile paralysis. In both diseases the essential pathological feature consists in microscopic areas of inflammation, with cellular infiltration, consisting largely of round cells, in the perivascular lymphatic sheaths and in the grey matter. In *Encephalitis lethargica* these changes were most noticeable in the upper part of the pons and in the basal nuclei. In the affected areas the nerve-cells showed the usual changes indicative of degeneration. In addition, Marinesco found degeneration of the Purkinje cells of the cerebellum in the two cases examined by him; such changes are similar to those observed by Mott in shell-shock, and previously studied by Crile, who considered them an expression of cellular exhaustion.

Thus the nervous lesions did not at all resemble those originally investigated by Marinesco in botulism. On the other hand, there are certain well-marked differences from infantile paralysis as regards the localisation of paralysis, which in the new disease mainly affects the cranial centres, while the spinal cord is commonly the site of lesions in infantile paralysis; also there is a practically equal incidence of the disease at all ages, whereas infantile paralysis affects mainly children and young adults. But such differences are possibly within the limit of variations which may occur in a clinical "entity" or "syndrome," since modern investigation of infective diseases in general has taught that the number of "typical" cases of any condition may constitute a variable, and sometimes relatively small, proportion of the total number.

The experimental results are of greatest importance, however, as tending to show that the two diseases are distinct in their causation. It has been well established by various observers in different parts of the world that in cases of infantile paralysis the central nervous system especially harbours the virus, and that the disease can be transmitted to monkeys by intracerebral inoculation with glycerinated emulsions of brain or spinal cord. On the other hand, McIntosh consistently failed to transmit the new disease to monkeys by injecting emulsions of nervous tissue from cases under similar conditions to those which are successful in poliomyelitis.

The disease, after obtruding itself in the spring and early summer of 1918, has again relapsed into obscurity for the time being. The valuable work in this report has outlined the natural history of the manifestations, but the failure to reproduce the disease experimentally or to identify any micro-organism as constantly associated with it has prevented the elaboration of a basis for dealing with a future outbreak. It may be presumed that, like infantile paralysis, it is a disease to which the majority of individuals are relatively resistant, and that healthy carriers, who harbour the virus in the nose and pharynx without themselves suffering from ill-effects, probably play a large part in dissemination. The practically simultaneous occurrence of *Encephalitis lethargica* in this country, France, and Austria is another of the unaccountable manifestations of the disease. C. H. B.

EXPLORATION OF NORTHERN GREENLAND.

THE second Thule Expedition to northern Greenland in 1916 to 1918, under the leadership of Mr. Knud Rasmussen, is the subject of articles in the *Geographical Review* for August and September (vol. viii., Nos. 2 and 3). With Thule on Melville Bay as a base, the main party of the expedition left on a long sledge journey to explore the northern coast of Greenland between Robson Channel and Peary Land. This coast had been only roughly sketched by Peary on one of his northern journeys. Mr. Rasmussen's party charted it in detail between St. George's Fjord and De Long Fjord. It was found that Nordenskjöld Inlet, at one time supposed to be the end of the so-called Peary Channel, but disproved in 1907 by Mylius Erichsen, is a short fjord ending in a glacier. The distribution of ice-free land was found to be the opposite of what was before believed to be the case, the land round St. George's Fjord being ice-free, and that round Nordenskjöld Inlet ice-covered. Mr. Rasmussen failed to find any ruins of Eskimo houses in that district, or any signs that Eskimo had ever migrated round the north coast of Greenland. This was previously supposed to be the route by which Eskimo at one time reached the east coast, where traces of camps and villages are numerous. Musk-oxen may have migrated in small herds round the north, but the general conditions of hunting are so poor that Eskimo are unlikely to have been attracted to the route. The ice-free areas are not large enough to furnish sufficient game for a wandering tribe, and the conditions of the pack-ice along the north-west coast make hunting on the sea impossible. Mr. Rasmussen believes that the east coast natives travelled from the west by Cape Farewell, and that reconnoitring parties of hunters went so far north as Independence Fjord. The botanical work of Dr. Thorild Wulff, who died from starvation, was important, and Mr. Lauge Koch obtained valuable geological results. The new map of the coast, of which a sketch is added to the article, was carefully prepared, forty observations of latitude and forty determinations of longitude being taken.

AQUATIC FAUNA OF SEISTAN.

UNDER the auspices of the Indian Medical Research Fund, Dr. N. Annandale and Mr. S. W. Kemp undertook in November, December, and January, 1918–19, an expedition to Seistan and Baluchistan with the object of discovering whether the disease Bilharziasis (or Schistosomiasis) occurred in Seistan, and, in particular, whether any of the known molluscan hosts of the parasite were to be found in that region. So far as the medical part of the inquiry was concerned the results were negative, but the opportunity was taken to make a collection of the limited aquatic fauna of the country. The zoological results of the expedition are now in course of publication as a special volume of the "Records of the Indian Museum" under the title of "Report on the Aquatic Fauna of Seistan." In an introductory essay Dr. Annandale describes the physiographical conditions of the Hamun-i-Helmand, the basin into which the

Helmand River flows, and which is occupied, according to season, by a large lake or by a series of lakes of variable area. Owing to the fact that in flood-time the Hamun overflows, by the Shelagh River, into the Gaud-i-Zirreh, "the Dead Sea of the Helmand system," its waters do not reach a high degree of salinity, and it sustains a fauna, impoverished indeed, but rich in comparison with that of true salt lakes. Dr. Annandale points out that although the Hamun occupies part of an ancient lake-bed, "there has been no biological continuity between the old lake and the recent one." The present lake may even have originated within historic times by a shifting of the course of the Helmand River. Dr. Annandale describes the Cyprinid fishes of the genus Discognathus found in the region and, in collaboration with Dr. B. Prashad, the Mollusca. In the case of the latter it is pointed out that the fauna shows a mingling of Palæarctic and Oriental types and a noteworthy absence of Western Asiatic elements. The fauna, however, "is a starved one, in which only species of great adaptability can survive."

PHYSICS AT THE BRITISH ASSOCIATION.

ONE day of Section A was devoted almost entirely to matters relating to wireless telegraphy. Prof. Eccles opened a discussion on thermionic valves, giving a general description of the history and development of the three-electrode valve, explaining its rectifying property, the method of heterodyne reception, and the arrangements necessary to produce continuous waves. Experiments were shown illustrating these uses of the valve, and the way was thus prepared for the discussion of special points by subsequent speakers. Prof. Fortescue directed attention to the functions and properties of the various parts of the valve in some detail. The hot filament is the source of the electrons upon which the action of the valve fundamentally depends; with tungsten filaments as at present used only 4½ per cent. of the energy heating the filament is usefully employed as electron emission. This efficiency might be improved by using oxide-coated filaments or higher temperatures, but at present neither of these methods has been entirely successful in practice. The construction of the grid and the question of freeing the anode and containing vessel from occluded gas during pumping were also discussed, and the importance of investigating the methods of removing the last traces of gas and examining their nature was emphasised. Dr. Whiddington directed attention to the possibility of using valves and oscillating circuits for making many standard physical measurements. Thus, for example, the coefficient of mutual induction can be determined by observing the degree of coupling at which oscillations are just started and maintained. He also alluded to Prof. Eccles's example of the extreme sensitiveness of heterodyne reception as illustrated by the effect of passing coal-gas between the plates of a condenser in an oscillating circuit. The temperature coefficient of resistance, the conductivity of flames, the permeability of liquids, and other quantities could also be measured by this delicate method.

In a paper entitled "A Wireless Method of Measuring e/m" Dr. Whiddington showed how oscillations may be set up in valve-circuits, not including capacities and inductances. The oscillations are produced by bursts of electrons from hot spots on the filament of a soft valve and the periodic return of positive ions from the space between the grid and anode. In the special experiments described it was shown from the value of e/m obtained that the ions consisted of mercury.

The report of the committee on wireless telegraphy was of special interest on account of the observations made on the strength of signals during the recent solar eclipse. It was, however, too early to give any very definite conclusions, although it was stated that Malta and Paris had received signals of increased intensity during the eclipse. Bearing on the same point, Prof. G. N. Watson gave a *résumé* of his recent work on the diffraction of electric waves, in which, starting from the Heaviside-Eccles hypothesis of conduction in the upper regions of the atmosphere, Austin's formula can be obtained as a result of certain simple assumptions.

Papers were read by Prof. Horton and Miss A. G. Davies and by Prof. Horton and Miss D. Bailey respectively on the ionisation by electron collisions in argon and helium and on the luminosity produced in the latter gas. It appears that there are two critical velocities of the electrons at which radiation from the atoms and ionisation occur respectively. In argon these two phenomena occur at 11·5 and 15·1 volts, and in helium at 20·4 and 25·6 volts. The results are of great interest, but, as Dr. Goucher pointed out, their interpretation seems still open to question.

The phenomena of novæ were dealt with in two papers by Mr. Stratton and Father Cortie. In the former paper the types of spectra occurring in the course of the history of Nova Geminorum were described. The observed displacements of the spectral lines correspond with velocities reaching 2×10^8 cm./sec., which are so large that electrical causes are suggested to explain them. Similar velocities were deduced from the observations on Nova Aquilæ, and, after sketching the sequence of progressive changes occurring in the star, Father Cortie concluded that a solar eruption in a giant star situated in a dark nebula would square with the observed spectral changes.

In an interesting communication on the theory of vision Sir Oliver Lodge put forward the suggestion that the retina may be found to contain atoms in such a condition of instability that impulses of the correct luminous frequency can excite them and cause the expulsion of electrons. A difficult but highly interesting experiment was suggested of trying to find in the retina chemical substances capable of emitting high-speed electrons when subjected to light.

Prof. Eddington gave an account of the observations which had been made at Principe during the solar eclipse. The main object in view was to observe the displacement (if any) of stars the light from which passed through the gravitational field of the sun. To establish the existence of such an effect and the determination of its magnitude gives, as is well known, a crucial test of the theory of gravitation enunciated by Einstein. Prof. Eddington explained that the observations had been partially vitiated by the presence of clouds, but the plates already measured indicated the existence of a deflection intermediate between the two theoretically possible values 0·87″ and 1·75″. He hoped that when the measurements were completed the latter figure would prove to be verified. Incidentally, Prof. Eddington pointed out that the presence of clouds had resulted in a solar prominence being photographed and its history followed in some detail. Some very striking photographs were shown.

Following on this account Prof. Eddington opened the discussion on relativity, and referred again to the bending of the wave-front of light to be expected from Einstein's new law when the light passes near a heavy body. It should be possible to test experimentally this

law, which demands that the speed of light varies as $1-2\Omega$, where Ω is the gravitational potential. He showed that, whether Einstein's solution of the problem be correct or not, it has, at any rate, given a new orientation to our ideas of space and time. Sir Oliver Lodge regarded the relativity theory of 1905 as a supplement to Newtonian dynamics by the adoption of the factor $(1-v^2/c^2)$ and its powers necessitated by experimental results; but he did not consider this dependence of mass and length on velocity as entailing any revolutionary changes of our ideas of space and time, or as rendering necessary the further complexities of 1915. He compared the difficulties involved with the case of measuring temperature, defined in terms of a perfect gas, and made with gases which only approximate to this ideal state. Dr. Silberstein pointed out that Einstein's theory of gravitation predicts three verifiable phenomena, *i.e.* a shift of spectral lines, the bending of light round the sun, and the secular motion of the perihelion of a planet. In the neighbourhood of a radially symmetric mass such as our sun, the line-element ds is given by

$$ds^2=(1-2M/c^2r)c^2dt^2-(1-2M/c^2r)(dx^2+dy^2+dz^2).$$

The coefficient c^2dt^2 gives by itself a lengthening of the period of oscillation for a terrestrial observer in the ratio $(1+M/c^2r):1$, demanding a shift of spectral lines of about 0·01 Å.U. Secondly, the path of rays of light is obtained by putting $ds=0$, and the first and second coefficients give jointly a bending which for rays almost grazing the sun is 1·75″. Thirdly, Keplerian motion is predicted with a progressively moving perihelion, which in the case of Mercury turns out to be 43″ per century. He directed attention to the fact that St. John's results in 1917 showed no shift of the spectral lines, which in itself would overthrow the theory in question. Father Cortie pointed out that Campbell's photographs taken in 1918 and measured by Curtis gave no trace of any displacement of the images of forty-three stars distributed irregularly round the sun.

Amongst other papers read at the meeting may be mentioned an account by Sir Frederick Stupart of weather conditions in Alberta and a paper by Prof. Forsyth on Gauss's theorem.

CHEMISTRY AT THE BRITISH ASSOCIATION.

IT was perhaps only to be expected that the programme of the Chemical Section should be coloured by the four years of war through which we had just passed, but, though war chemistry took a prominent place, more academic subjects were not entirely relegated to the background.

Some excellent summaries of work in different branches of chemistry during the war were given by various speakers.

Sir William Pope spoke on the general subject of the position of chemistry in Germany and this country as a result of the war, and pointed out that while German chemical industries emerged from the war in a strengthened position, ours remained much as they were, and that we were faced with a great, immediate danger in a strong propagandist movement to rehabilitate the German chemist in the eyes of the world.

Brig.-Gen. Hartley described the development of chemical warfare and the measures taken to counteract its destructive effects by means of gas-masks, etc. This particular form of warfare is, perhaps, not so inhuman as it is often regarded to be; for if it be granted that human lives must be sacrificed and suffering endured to achieve military objectives, then such objectives can often be attained by the use of gas attacks, lachrymatory shells, etc., with less loss of life and permanent injury than by the employment of high explosives.

Col. C. D. Crozier reviewed the output and methods of manufacture of high explosives during the war, directing attention to the improvements in method and quality which took place as the exigencies of the military situation called for an ever-increasing output, and claimed that this result was due in no small part to the activities of the Inspection Department.

Prof. Desch gave an excellent *résumé* of the metallurgical position in this country and the Central Empires, and showed how metallurgical considerations entered into the Franco-German Peace of 1871, and largely influenced the war and the territorial readjustments of the Peace Treaties. The necessities of war, if without any striking metallurgical developments, have at any rate, so far as this Empire is concerned, done much to stimulate the working within the Empire of locally produced ores, while fresh industries have arisen to smelt ores of metals hitherto imported from enemy countries. In Germany, as might have been expected, the study and use of substitutes for such metals as copper, nickel, and manganese have received close attention.

A paper by Dr. M. W. Travers described the position of the glass trade after the war. Though much has been done to supply the demand for various kinds of glass in this country, Dr. Travers must undoubtedly be written down as an optimist when he declares we can now supply from home-made stock all requirements of laboratory glass and glass for scientific purposes. We fancy few universities and schools would endorse his view, as most of them have great difficulty in supplying the requirements of their students.

Prof. Boswell contributed a paper on some recent problems in geo-chemistry. The border-line of chemistry and geology presents problems of the greatest interest and value as regards the sources and supply of raw materials for chemical manufactures, and the necessity of finding fresh material or substitutes during the war has greatly stimulated geochemical research. Prof. Boswell reviewed the different problems created by war demands, and showed how geo-chemistry has developed our home supplies of materials formerly obtained from enemy countries.

A short but interesting paper by Major E. R. Thomas on the work of an ammunition chemist in the field concluded the papers directly dealing with the war. Major Thomas, with improvised appliances and some Chinese coolies for labour, recovered upwards of a ton daily of KNO_3 and pitch from condemned ammunition. Major Thomas deserves the warmest praise for setting an example of economy and showing that so-called waste is really valuable material.

Though not directly dealing with war chemistry, a paper by Drs. Lowry and Perman on the equilibrium in the system ammonium nitrate—sodium chloride—sodium nitrate—ammonium chloride gave the results of much work conducted for war purposes.

Several papers were contributed from H.M. Naval Cordite Factory at Holton Heath, dealing mainly with industrial bacteriological problems such as the preparation of acetone and industrial alcohol, though a few of them dealt with pure organic chemistry. Special mention must be made of the paper by Dr. A. C. Thaysen, which gave a capital review of different aspects of bacteriology outside medicine, and showed how large a field of investigation is open to

bacteriologists in a technical rather than a microscopical sense.

A discussion took place on the report of the Fuel Economy Committee. At nearly every recent meeting of the association a somewhat similar discussion has taken place, and though fuel economy is far more imperative now than it has ever been, and is most unpleasantly brought home to all of us by our local Coal Controllers, it cannot be said that the discussions have been very constructive. They range over a wide field, they are disjointed, and while each speaker's communication is of value in itself, the discussion as a whole somehow seems unreal and almost futile. One wishes that the committee round the report of which the discussion centres were able to present definite propositions which, if approved after due discussion, could be sent through the council of the association to the Government Department, or whomever else they concerned. They would be received with more of the importance due to them if they came from the British Association as a whole. Fuel economy, however, is so vast a subject that probably the committee has scarcely had time yet to distil the essence from the great quantity of valuable material it is collecting.

Prof. E. C. C. Baly, Prof. A. Lapworth, and Prof. R. Robinson wound up the meeting with three papers on pure chemistry of great interest, since they all dealt with the mechanism of chemical reaction. In these papers the writers discussed the molecular and other aspects of chemical reactivity. It is refreshing to find that the great demands of war on the genius of chemists has not smothered the efforts of those who seek to probe deep into the very fundamentals of the science.

Mention must be made of a very enjoyable and interesting excursion to the Naval Cordite Factory at Holton Heath. By kind invitation of the superintendent, Capt. Desborough, eighty members of the Section were shown all over the factory, which in its completeness is second to none.

In conclusion, it should be stated that the meetings of the Section were very well attended, and more enthusiasm was shown than for many years past.

ZOOLOGY AT THE BRITISH ASSOCIATION.

SECTION D attracted a representative gathering of zoologists, and the papers were the subject of much interesting discussion. The following is a summary of the proceedings of the Section :—

Mr. E. S. Goodrich, in a paper on phagocytosis and protozoa, stated that phagocytosis of living protozoa had rarely been observed in vertebrates. Invertebrates deal more successfully with protozoal parasites; the leucocytes cling together, surround and finally smother a parasite. This power of aggregation appears to be due to the fact that the floating leucocytes are provided, not with outstanding pseudopodia, but with delicate films of protoplasm ready to spread over any foreign substance. It is the optical sections of these folded films which are usually figured as pseudopodia.

Mr. E. Heron-Allen, for Mr. Earland and himself, directed attention at a joint meeting of Sections D and K (Botany) to some hitherto unemphasised modifications of growth in the life-history of Foraminifera. He exhibited slides showing the modifications brought about by the cultivation of Foraminifera in hypertonic sea-water, the affinity of certain genera for gems as building material, and the power of selection of material exercised by certain species.

Dr. A. C. Coles exhibited photomicrographs of *Leptospira icterohaemorrhagiae*—the organism of infective jaundice in man—from the kidney of local rats.

Mr. A. T. Watson gave further details on the tube-building operations of the Polychæte worm, *Pectinaria koreni*.

Prof. E. W. MacBride described some further experiments on the artificial production of Echinus larvæ with a double hydrocœle. He stated that the optimum result was obtained when larvæ three days old were transferred from normal to hypertonic sea-water for a week or ten days and then put back into normal sea-water, and he offered a tentative explanation.

Prof. G. H. F. Nuttall gave a lecture on "Lice and their Relation to Disease." Commencing with the biology of *Pediculus humanus*, of which there are two races—*capitis*, the head-louse, and *corporis*, the body-louse—Prof. Nuttall described the mode of oviposition, the development, hatching, moulting, feeding, etc. The female lays 150 to 300 eggs, and under favourable conditions the life-cycle from egg to egg is completed in sixteen to seventeen days. Under experimental conditions dark or pale lice can be reared at will according as they are raised on dark or light backgrounds respectively. Hermaphrodites in large number have been obtained by crossing the two races *capitis* and *corporis*. After pointing out that lice transmit relapsing, typhus, and trench fevers, Prof. Nuttall described some of the methods of control on a large scale, *e.g.* hot-air disinfestors (Orr's huts) and railway vans into which steam from a locomotive was introduced under pressure.

Dr. E. Hindle traced the history of isolated pairs of body-lice and of their offspring raised through five generations. Out of sixty families, twenty-four were mixed (composed of males and females), nineteen were female, thirteen male, and four crosses were sterile. The lice were all fed on the same individual and under similar conditions, and no explanation of the occurrence of the three sorts of families could be discovered. The proportion of females to males in the total number of adults raised to maturity agreed almost exactly with that occurring in Nature—60 per cent. females and 40 per cent. males.

Dr. M. C. Grabham gave an account of the Argentine ant (*Iridomermyx humilis*) in Madeira. The ant was introduced twenty-seven years ago, but was only identified three years later, when it had become firmly established. Coffee cultivation has been ruined and every sort of fruit-tree—citrus especially—which would support coccus or aphis has been almost entirely destroyed. Sugar-cane and bananas still exist, though badly attacked, but sweet potatoes have disappeared in many districts. Attention was directed to the methods of the ant in searching for food, and to the harmony in working, there being a singular absence of fighting when separate communities meet. The ant has few enemies, *e.g.* spiders and Pholcus. A covering of powdered chalk on the basal part of the trunk of a tree is a deterrent to the ant, and banding the trees with rags soaked in corrosive sublimate has also been found effective. Dr. Grabham suggested that our Colonies should be warned as to the importance of this pest.

Prof. Dendy delivered a lecture on "Grain-pests and the Storage of Wheat," for the main points of which the reader is referred to NATURE for March 20 last, p. 55.

Before a joint meeting of Sections C (Geology) and D, Mr. C. Tate Regan spoke on the distribution of fresh-water fishes, with special reference to the past history of continents. He dealt particularly with the Ostariophysi—the dominant group of fresh-water fishes—and took the view that they originated in Gondwana Land in Cretaceous times, and that Australia and Mada-

gascar became isolated before these fishes could reach them. The severance of Africa from South America and from southern Asia probably left Characiformes and Pimelodidæ in South America, Characiformes and Bagridæ in Africa, and Cypriniformes and Bagridæ in southern Asia. At the end of the Cretaceous new land connections may have enabled the ancestors of the Catostomidæ and Amiuridæ to reach North America through eastern Asia. Isolation of the continents during the Eocene helped the development of endemic types, and the union that followed in the Oligocene or Miocene probably gave Cyprinidæ to North America and a few Nearctic fishes to eastern Asia.

Prof. MacBride and Mr. Goodrich expressed some doubts as to the value of the evidence, on the zoological side, for the existence of Gondwana Land, but Dr. D. H. Scott regarded the evidence afforded by the Glossopteris flora as strongly in favour of the former existence of such a land area. Mr. D. M. S. Watson considered that the evidence from fossil plants, Pelecypoda, and vertebrates indicated a connection between Africa and America in Permian times, but whether this continued to the Cretaceous was doubtful.

Dr. J. W. Evans did not agree with those who dwelt on the incompleteness of the evidence for the existence of Gondwana Land. He was inclined to look with favour on the view that the land-masses had not always held their present relative positions, *e.g.* Africa and South America may have been nearer together. The Falkland Islands show closer geological relationship to Africa than to America.

Mr. Tate Regan, in replying, reaffirmed his belief in the former existence of Gondwana Land.

Before the same joint meeting Mr. D. M. S. Watson gave a paper on "Palæontology and the Evolution Theory," an account of which will be given in the article upon the proceedings of the Geological Section.

Dr. Marie Lebour summarised the results of her investigations, extending over three seasons at Plymouth, on the food of larval and post-larval fishes. Most of the fish examined were from 0·5 mm. to 15 mm. in length. The greater portion of their food consists of Entomostraca; diatoms seem to be little eaten by young fish except at a very early stage. Other unicellular organisms are rarely found in young fish, but the flounder up to about 10 mm. in length was found to be feeding exclusively on the flagellate Phæocystis, but at about 11 mm. it changes to a diet of copepods. Larval molluscs, though often abundant in the plankton, are much more seldom found than Crustacea in young fishes. The young fishes thus select their food to a great extent, but that which is selected is generally common, and there is no indication of any special migration on the part of the pelagic young in search of food.

Mr. L. P. W. Renouf gave an account of the development of the Bute Laboratory and Museum.

J. H. ASHWORTH.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

THE helpful paper, "On Lecturing with the Lantern," by Prof. G. A. J. Cole, which appeared in the *Journal of the Department of Agriculture and Technical Instruction for Ireland* (vol. xix., No. 1), has been reprinted with the permission of the Department, and is now published as a pamphlet by Mr. T. H. Mason, Dame Street, Dublin.

APPLICATIONS for the Tyndall Mining Research Fund studentship are invited by the Royal Society. The studentship is for study and research on subjects relating to mining and the safety of miners, is of about 35*l.* in value, and open to any British subject. Applications must reach the Assistant Secretary of the Royal Society not later than January 15, give particulars of the kind of research it is proposed to carry out, and where, and be accompanied by not more than two testimonials or references.

YALE UNIVERSITY is offering two Theresa Seessel research fellowships for the promotion of original research in biological studies. Each fellowship will be of the value of 200*l.*, and preference will be given to candidates who have obtained their doctorate and demonstrated their fitness to carry out successfully original research work of a high order. Applications, accompanied by reprints of scientific publications, letters of recommendation, and particulars of the problem proposed by the candidate for investigation, must be made before May 1 next to the Dean of the Graduate School, New Haven, Conn., U.S.A.

THE Association of Science Teachers has issued a list of science books which are suitable for use in schools. That a compilation of this sort is a matter of some difficulty is doubtless the reason for its being so rarely attempted. The association has done well to risk imperfection so as to supply an obvious need. The list, which contains the names both of text-books for the use of pupils and of books of reference for the library shelf, is attractively printed and reasonably classified. It is to be regretted that biology (as distinct from botany) and astronomy find no place in the main divisions, despite the fact that Dr. Sophie Bryant, in her excellent foreword, directs attention to the desirability of these subjects in the early stages of a child's training. The "Book List (1919)," which we hope will become a periodical publication, may be obtained for 1*s.* 1*d.* from Miss F. Storr, hon. secretary of the association, 12 Angell Park Gardens, S.W.9.

WE are used to large private benefactions for education and science in the United States, but the announcement made in the *Times* of December 27 of a gift of 25,000,000*l.* for these purposes from Mr. John D. Rockefeller is really marvellous to those of us who know how little private generosity can be depended upon for like needs in our own country. The gift is divided into two equal parts of 12,500,000*l.* each to the General Education Board and to the Rockefeller Foundation. It is the largest sum of money ever given at one time to philanthropy, and it brings the total amount of Mr. Rockefeller's donations to 100,000,000*l.* The donation now announced is to be devoted to two purposes:—(1) To some plan of increasing the salaries of the teaching staffs of the colleges and universities of the United States; and (2) to the promotion of the objects of the Rockefeller Foundation, which are defined as the well-being of mankind throughout the world. The General Education Board was founded by Mr. Rockefeller in 1903, and the general purpose of the corporation is "the promotion of education within the United States of America, without distinction of race, sex, or creed." The principal funds of the board have been about 9,000,000*l.*, and grants amounting to about 400,000*l.* have been made annually to various institutions. It was only a couple of months ago that Mr. Rockefeller added 2,500,000*l.* to his previous endowment of the Rockefeller Institute for Medical Research. This gift was to meet rapidly growing needs in the institute's many lines of research and also to make new knowledge available in the protection of the public health and in the improved treatment of disease and injury.

ONE of the notable features of the great struggle in which the nation has been engaged, and for which recruits were drawn from all classes of the United

Kingdom, was the effort made, in camps both at home and abroad, to continue, however imperfectly as to means and methods, the education already gained, having regard to the fact that sooner or later large numbers of men would return to civil occupations and duties, and that it would be desirable, so far as time and circumstances permitted, that military service should offer opportunities of continued study. It is gratifying to observe that the Army of Occupation on the Rhine, which numbers 250,000 men, is animated by the same spirit. The 222nd number of the *Cologne Post*, a daily paper printed and published at Cologne in English for the Army of Occupation, and the Christmas souvenir number of the same journal (price 9*d*., or 7 marks), both contain articles urging the vital importance of education, not only in its general and scientific aspects, but also as applied to the promotion of special phases of industry, of commerce, and of agriculture, with the view of fitting men for these several pursuits, and describes the means taken at Cologne and other Rhine towns for effective instruction and training in the various subjects by the institution of laboratories, workshops, and field allotments. At Siegfried there was held recently an exhibition in which was displayed a great deal of good work, the results of training men who had previously learned no trade to become wage-earners of the best possible type. The courses of study include educational facilities extending from the absolutely illiterate to the university graduate, but these articles are also remarkable for the point of view they express, namely, that the soldiers are urged on returning home to civilian life to insist that their children shall receive their due, and be trained to think and to appreciate the beauties of life.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Meteorological Society, December 17.—Sir Napier Shaw, president, in the chair.—F. J. W. **Whipple**: The laws of approach to the geostrophic wind. The mode of transition from the winds near the surface of the earth to the general current at moderate heights has been discussed by various authors. In the present paper stress is laid on the geometrical aspect of the question. The term "relative wind velocity" being used for the velocity which must be combined with the geostrophic wind velocity by vector addition to give the actual wind velocity at any level, the laws of approach to the geostrophic wind are:—(1) The relative wind turns uniformly with increasing height; (2) the relative wind decreases with increasing height according to the exponential law; and (3) the actual wind at the surface and the relative wind there are inclined at 135°.—G. M. B. **Dobson**: Winds and temperature-gradients in the stratosphere. From the results of temperature observations by *ballon-sondes*, it can be shown that the horizontal pressure-gradient, and therefore the wind velocity, should decrease rapidly on passing from the troposphere to the stratosphere. Previously there had been little confirmation of this by actual observations. Seventy ascents recorded by the International Commission gave data for temperature, wind velocity, and wind direction to great heights. These showed that, almost without exception, winds of moderate or great velocity in the troposphere fall off very rapidly on entering the stratosphere, while the wind direction remained constant. On days with small pressure-gradients this effect was not usually found—a result which was to be expected, since the slope of the tropopause would then not necessarily be towards the low pressure. Horizontal pressure and temperature-gradients calculated for the observed winds on typical days with moderate or large pressure-gradients show that the pressure-gradient is suddenly reduced, and the temperature-gradient suddenly reversed, on entering the stratosphere. The temperature-gradients calculated from the observed wind velocities are in good agreement with those deduced by Mr. W. H. Dines from temperature and pressure observations.—Capt. C. J. P. **Cave**: Quotations from the Diary of Samuel Pepys on the weather. In this the author has collected together all references to the weather from the "Diary," using for this purpose Wheatley's edition. These amount to as many as 557 entries, and are arranged in chronological order. They form a brief comment on the general weather conditions prevailing from January, 1660, to May, 1669. In a preliminary essay the author summarises the principal weather events for each year. He points out that Pepys cannot claim to be considered as a meteorologist, and that his references to the weather are such as anyone might make in writing a diary or in correspondence. He also states that Pepys's memory for meteorological events was not always good, and his remarks on the worst or best weather he remembers must be taken with caution.

EDINBURGH.

Royal Society, November 3.—Prof. F. O. Bower, president, in the chair.—Capt. T. B. **Franklin**: The cooling of the soil at night, with special reference to late spring frosts. The aim of this investigation was to obtain data on which predictions might be formed as to the coming night temperature. Continuing a course of investigation, the author gives a formula whereby the minimum temperature on any calm, clear night may be known by about 5 p.m. on the previous afternoon. A comparison of his results with the observed minimum soil temperatures on twenty favourable nights between April and October, 1919, shows an average error of 0·3° C. only; it would thus appear that, under the weather conditions favourable to spring frosts, it is possible to forecast the occurrence of a frost with great exactness.—Sir Thomas **Muir**: Note on the determinant the matrix of which is the sum of two circulant matrices.—G. F. **Quilter**: Note on and exhibition of photographs of appearances of mirage at Ingatestone. These photographs showed apparent pools of water in the street in which pillars appeared reflected at a distance of about a hundred yards. The photographs were interesting as following up a previous paper by Mr. Alex. G. Ramage communicated to the society in 1918.

December 1.—Prof. F. O. Bower, president, in the chair.—Dr. R. **Kidston** and Prof. W. H. **Lang**: Old Red Sandstone plants showing structure from the Rhynie Chert bed, Aberdeenshire. Part iii.: *Asteroxylon Mackiei*, Kidston and Lang. The fourth vascular Cryptogam found in the silicified peat-bed at Rhynie, the age of which is not younger than the middle Old Red Sandstone of Scotland, was a larger and more complex plant than *Rhynia Gwynne-Vaughani*, *R. major*, and *Hornea Lignieri*, described in the earlier papers of this series. It has been named *Asteroxylon Mackiei* after Dr. Mackie, the original discoverer of the chert-bed. The remains of Asteroxylon are abundant, though fragmentary, and give, with more or less certainty, a fairly complete knowledge of the plant.

December 8 and 9.—Prof. W. Peddie, vice-president, in the chair.—Prof. R. A. **Sampson**: (1) Newton's views on gravitation and their subsequent history. (2) The theory of Einstein and its observational tests. In the second address, by the kindness of Sir Frank Dyson, the Greenwich photographs taken at the expedition to

Sobral, Brazil, were exhibited, and the method of measurement and agreement obtained were explained. It was pointed out that the first success of Einstein's theory was to explain completely a long-outstanding discrepancy in connection with the orbit of Mercury. Of the two other tests, which were in the form of predictions, one, that gravity would modify the solar spectrum, had not been verified, while the second, that light from a star passing near the sun would be deviated, had been verified. The general processes by which Einstein derived this formula carried no assurance that the results would describe Nature, and the theory must rest upon such tests as he himself has proposed for it. From this point of view, though it shows its changes only in minute remote phenomena, its claims are too vast to be settled in a short time.

PARIS.

Academy of Sciences, December 1, 1919.—M. Léon Guignard in the chair.—P. A. **Dangeard**: The distinction of the chondriome into vacuome, plastidome, and spherome.—The **Prince of Monaco**: The oceanographic study of the Mediterranean. An account of an international conference held at Madrid on November 17 last, at which France, Italy, Spain, Greece, Monaco, Egypt, and Tunis were represented.—G. A. **Boulenger**: The distribution in Africa of the barbel, sub-genus Labeobarbus.—G. **Bouligand**: The problem of Dirichlet for an infinite domain.—R. **Soreau**: Experimental laws of the variations of barometric pressure and of the specific gravity of air with altitude. From forty series of observations with sounding balloons, carried out in 1912 at Trappes, Uccle, Strasburg, Hamburg, Munich, Pavia, and Vienna at heights up to 23 km., formulæ are deduced giving the pressure and density as functions of the altitude.—H. **Godard**: Observation of Finlay's periodic comet (1919e) made at the Bordeaux Observatory with the 38-cm. equatorial. Position of comet and comparison star given for November 25.—M. **Auric**: The cycle of eclipses. The ratio l/d is expressed in continued fractions, the fifth of which, $\frac{242}{223}$, was known to the Chaldeans as the Saros cycle; its error is 0·036 day in 18 years. The fraction $\frac{4004}{4519}$ is in error by only 0·0003 day in 365·4 years.—G. **Sagnac**: The direct comparison of the two simultaneous mechanical systems of radiation. Method of showing the translation of the earth.—S. **Procopiu**: Layers of metal, of minimum thickness, measured by their electromotive force.—H. **Abraham**, E. **Bloch**, and L. **Bloch**: The ultra-rapid kinematograph. The film is moved continuously and the object illuminated by electric sparks. With the arrangement described and figured, upwards of twenty thousand photographs per second can be taken on the film.—G. A. **Hemsalech**: The spectra emitted by the red fringe and luminous vapour in the neighbourhood of a plate of incandescent graphite.—C. **Staehling**: The radio-activity of uranium. An account of some experiments undertaken in an attempt to split up uranium into uranium I. and uranium II. The attempt at separation was unsuccessful, but some of the phenomena described do not appear to be simply explained by the current theories of radio-activity.—G. **Claude**: The synthesis of ammonia at very high pressures. The results of a series of experiments on the formation of ammonia from its elements in presence of a catalyst at pressures varying between 200 and 1000 atmospheres and at temperatures between 536° C. and 740° C. are given graphically. At 1000 atmospheres and 536° C. the percentage of ammonia in the mixture amounts to 41 per cent. Having regard to the reaction velocity as well as yield, the zone of utilisable temperature is between 500° C. and 700° C. The yield per gram of catalyst per hour is much higher than that obtained in German works.—L. **Guillet**: The transformation undergone by certain aluminium alloys. It was shown about twenty years ago that certain alloys of aluminium with iron, manganese, and nickel rapidly fell to powder on exposure to air. This phenomenon has been further investigated, and it is found that the change in the aluminium-manganese alloy is due to an allotropic modification, whilst the aluminium-antimony alloy oxidises in moist air. The iron and nickel alloys did not change, and it is probable that some unknown impurity was the cause of the falling to powder observed in the earlier experiments.—P. **Dejean**: The critical points of self-tempering steels.—A. **Kling**, D. **Florentin**, A. **Lassieur**, and R. **Schmutz**: The preparation of chloromethylchloroformates. The existence of monochloromethyl- and dichloromethyl-chloroformates is proved and methods for their preparation are described.—L. **Moret**: The discovery of lacustral Eocene beds at the Roc de Chère (Lake of Annecy).—L. **Mercier** and C. **Lebailly**: Primitive cancer of the pancreas and giant cells in mice.—P. **Bugnon**: The use of commercial inks in plant histology. Some commercial inks of French manufacture can be employed with advantage as histological stains. Two formulæ for triple stains are given in which ink is one of the constituent dyes.—J. **Offner**: Phytogeographical remarks on the massifs of Vercors and Dévoluy.—M. **Baudouin**: The fibula of a newly born infant of the Polished Stone period, and consequences in anatomical philosophy. The faces of the bone are smooth and free from the grooving found in the Neolithic adult. The grooves are therefore acquired, being due to special muscular actions depending on the mode of walking of these prehistoric men.—MM. G. **Bertrand**, **Brocq-Rousseu**, and **Dassonville**: The influence of temperature and other physical agents on the insecticidal power of chloropicrin. When using chloropicrin against insects the intensity of the light and the hygrometric state of the air need not be taken into account; the temperature, however, is of importance; the higher the temperature, the more rapid is the destruction of the insects.—T. **Kabéshima**: Experimental researches on preventive vaccination against the dysentery bacillus of Shiga.

CALCUTTA.

Asiatic Society of Bengal, December 3, 1919.—Dr. N. **Annandale**: A loom used by the Gaodar herdsmen of Seistan. The loom, though of very simple structure, seems to be degenerate rather than primitive, its peculiarities depending not so much on lack of skill in its makers as on lack of proper materials, notably wood.—V. H. **Jackson** and A. T. **Mukerjee**: Improvements in measurements with quadrant electrometers. Part ii. Simplified arrangements for accurate and continuous work. During most months in the year accurate measurements with sensitive quadrant electrometers cannot be made in India without special precautions, owing to the high temperature and humidity. In continuation of earlier work the authors have now considerably simplified the arrangements for accurate and continuous work.—V. H. **Jackson** and A. T. **Mukerjee**: The utility of desiccants in electrostatic measurements. The authors have tested the relative efficiency of the various desiccants used in electrostatic measurements under strictly uniform conditions, using Dolezalek electrometers with the arrangements described in the previous paper. Calcium chloride has been found quite unsatisfactory, metallic sodium (extensively used in Germany) and phosphorus pentoxide worse than useless, and quicklime only temporary in its effect. Strong sulphuric acid is the only satisfactory desiccant for this purpose.

BOOKS RECEIVED.

Applied Chemistry. By Dr. C. K. Tinkler and H. Masters. Vol. i. Pp. xii+292. (London: Crosby Lockwood and Son.) 12s. 6d. net.

Wonders of Insect Life. By J. H. Crabtree. Pp. viii+211+32 plates. (London: G. Routledge and Sons, Ltd.) 6s. net.

The Natural Wealth of Britain. By S. J. Duly. Pp. x+319. (London: Hodder and Stoughton.) 6s. net.

Instincts of the Herd in Peace and War. By W. Trotter. Second edition. Pp. 264. (London: T. Fisher Unwin, Ltd.) 8s. 6d. net.

Popular Chemical Dictionary. By C. T. Kingzett. Pp. vi+368. (London: Baillière, Tindall, and Cox.) 15s. net.

Industrial Gases. By Dr. H. C. Greenwood. Pp. xvii+371. (London: Baillière, Tindall, and Cox.) 12s. 6d. net.

Fifty Years in the Royal Navy. By Admiral Sir Percy Scott. Pp. xviii+358. (London: John Murray.) 21s. net.

The Fungal Diseases of the Common Larch. By W. E. Hiley. Pp. xi+204. (Oxford: At the Clarendon Press.) 12s. 6d. net.

A Non-Euclidean Theory of Matter and Electricity. By P. A. Campbell. Pp. 44. (Cambridge, Mass.: G. H. Kent.) 35 cents.

DIARY OF SOCIETIES.

THURSDAY, JANUARY 1.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Prof. W. H. Bragg: The World of Sound: Sound and Music (Christmas Lectures).

FRIDAY, JANUARY 2.

ROYAL GEOGRAPHICAL SOCIETY (at Æolian Hall), at 3.30.—Miss Hilda Bowser: A Visit to the Diamond Mountain in Korea (Christmas Lecture to Young People).

ROYAL SOCIETY OF ARTS (Indian Section), at 4.30.—A. P. Morris: Burmese Village Industries: Their Present State and Possible Development.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—A. V. Sims: Automatic Electric Weighing Machines, as used with Machine Packers.

SATURDAY, JANUARY 3.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Prof. W. H. Bragg: The World of Sound: Sounds of the Country (Christmas Lectures).

MONDAY, JANUARY 5.

BRITISH PSYCHOLOGICAL SOCIETY (Education Section) (in Mathematics Theatre, University College), at 2.30.—Dr. P. B. Ballard: The Development of Mental Tests.

ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 8.

SOCIETY OF CHEMICAL INDUSTRY (at Chemical Society), at 8.—E. V. Evans: The Natural and Acquired Facilities Existing in the Occupied Area of Germany for the Manufacture of Chemical Products—the Outstanding Impressions resulting from an Inspection of Chemical Works in that Area, and a Consideration of the General Position in the Light of more Recent Developments in this Country.—Dr. G. S. Walpole: The Collective Effort of German Chemistry Industry.

ROYAL GEOGRAPHICAL SOCIETY (at Æolian Hall), at 8.30.—Prof. J. W. Gregory: The African Rift Valleys.

TUESDAY, JANUARY 6.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Prof. W. H. Bragg: The World of Sound: Sounds of the Town (Christmas Lectures).

ROYAL PHOTOGRAPHIC SOCIETY (Technical Meeting), at 7.—Dr. G. H. Rodman: The X-Rays approached from the Popular Standpoint.

RÖNTGEN SOCIETY (at Medical Society of London), at 8.15.

WEDNESDAY, JANUARY 7.

ROYAL SOCIETY OF ARTS, at 3.—L. Pendred: Railways and Engines (Juvenile Lecture).

PHYSICAL SOCIETY OF LONDON (at Exhibition of Apparatus, in conjunction with the Optical Society, at the Imperial College of Science), at 4.—Prof. Rankine: The Use of Light in the Transmission and Reproduction of Speech; at 8.—Prof. F. J. Cheshire: Some Polarisation Experiments.

GEOLOGICAL SOCIETY OF LONDON, at 5.30.—S. S. Buckman: Jurassic Chronology: I. Lias. Supplement I. West England Strata.—F. J. North: Syringothyris, Winchell, and Certain Carboniferous Brachiopoda referred to Spiriferina.

ROYAL SOCIETY OF MEDICINE (Surgery, Subsection of Proctology), at 5.30.—Dr. W. M. Telling and Others: Diverticulitis.

ROYAL AERONAUTICAL SOCIETY (at Royal Society of Arts), at 8.

INSTITUTION OF AUTOMOBILE ENGINEERS (at Institution of Mechanical Engineers), at 8.—Lt.-Col. D. J. Smith; Producer Gas for Motor Vehicles.

THURSDAY, JANUARY 8.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Prof. W. H. Bragg: The World of Sound: Sounds of the Sea (Christmas Lectures).

PHYSICAL SOCIETY OF LONDON (at Exhibition of Apparatus, in conjunction with the Optical Society, at the Imperial College of Science), at 4.—Prof. F. J. Cheshire: Some Polarisation Experiments; at 8.—Prof. Rankine: The Use of Light in the Transmission and Reproduction of Speech.

INSTITUTION OF ELECTRICAL ENGINEERS (at Institution of Civil Engineers), at 6.—J. Shepherd: Failures of Turbo-Generators and Suggestions for Improvements.

OPTICAL SOCIETY, at 7.30.

INSTITUTION OF AUTOMOBILE ENGINEERS (at 28 Victoria Street), at 8.—T. Clarkson: Steam Vehicles.

FRIDAY, JANUARY 9.

ROYAL ASTRONOMICAL SOCIETY, at 5.

MALACOLOGICAL SOCIETY OF LONDON (at the Linnean Society), at 6.—Dr. S. S. Berry: A New Species of Mitra from California.—Dr. A. E. Boycott: Local Variation in Size of *Clausilia bidentata* and *Ena obscura*.—H. C. Fulton: Molluscan Notes, IV.

SATURDAY, JANUARY 10.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Prof. W. H. Bragg: The World of Sound: Sound in War (Christmas Lectures).

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Editorial and Publishing Offices:

MACMILLAN AND CO., LTD.,

ST. MARTIN'S STREET, LONDON, W.C.2.

Advertisements and business letters to be addressed to the Publishers.

Editorial Communications to the Editor.

Telegraphic Address: PHUSIS, LONDON.

Telephone Number: GERRARD 8830.